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Classification of Public Domain

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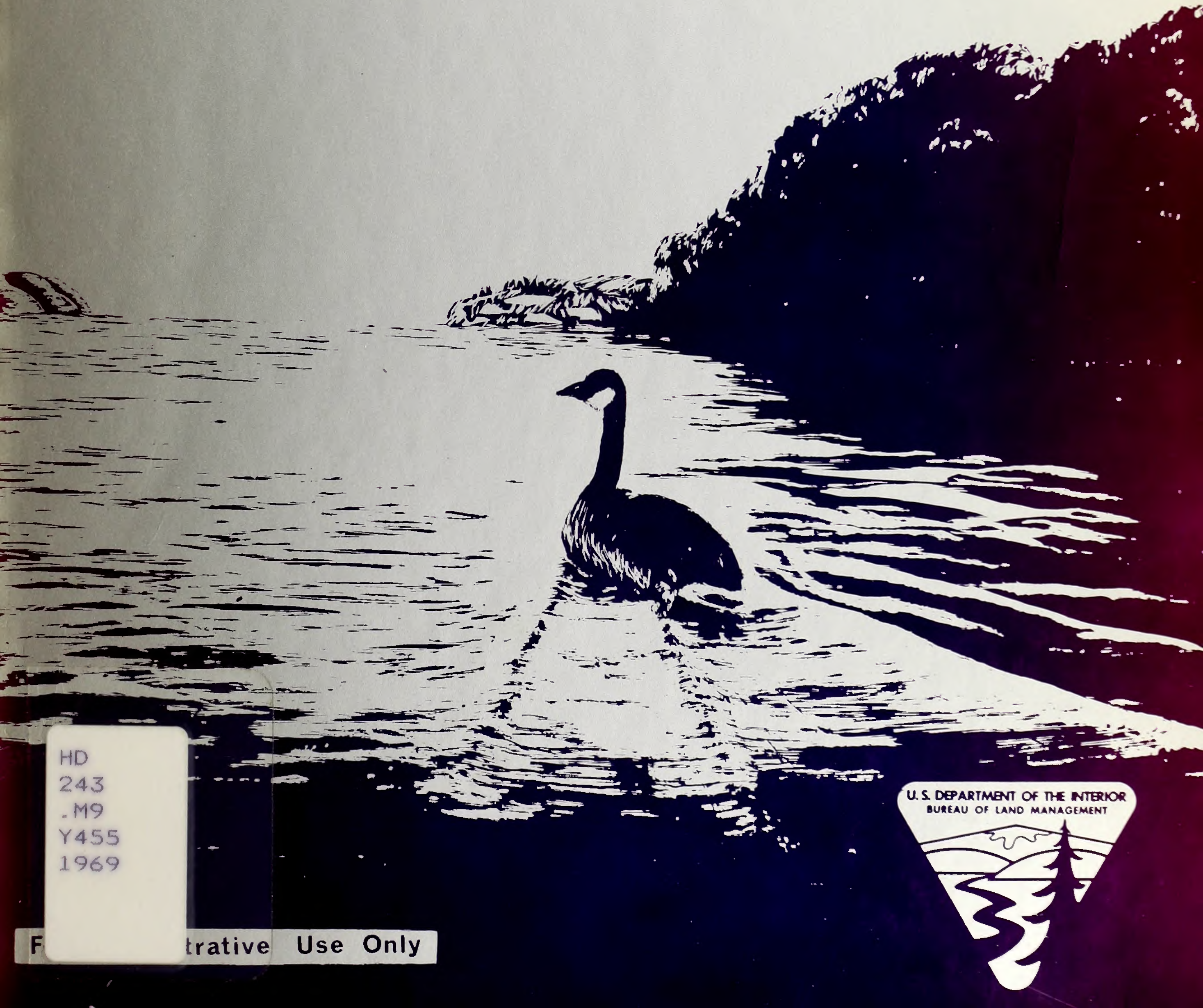

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Land Planning and Classification Report
# of the public domain lands
in the
MIDDLE YELLOWSTONE RIVER AREA
MONTANA

A Missouri River Basin Investigation

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DEPARTMENT OF THE INTERIOR

BUREAU OF LAND MANAGEMENT

DENVER, COLORADO

1969

This report was compiled as a feature of the program of the Department of the Interior for the development of the resources of the Missouri River Basin.

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PRESENT STATUS OF BUREAU OF LAND MANAGEMENT STUDIES IN THE MISSOUR RIVER BASIN

(LAND CLASSIFICATION)

June, 1969

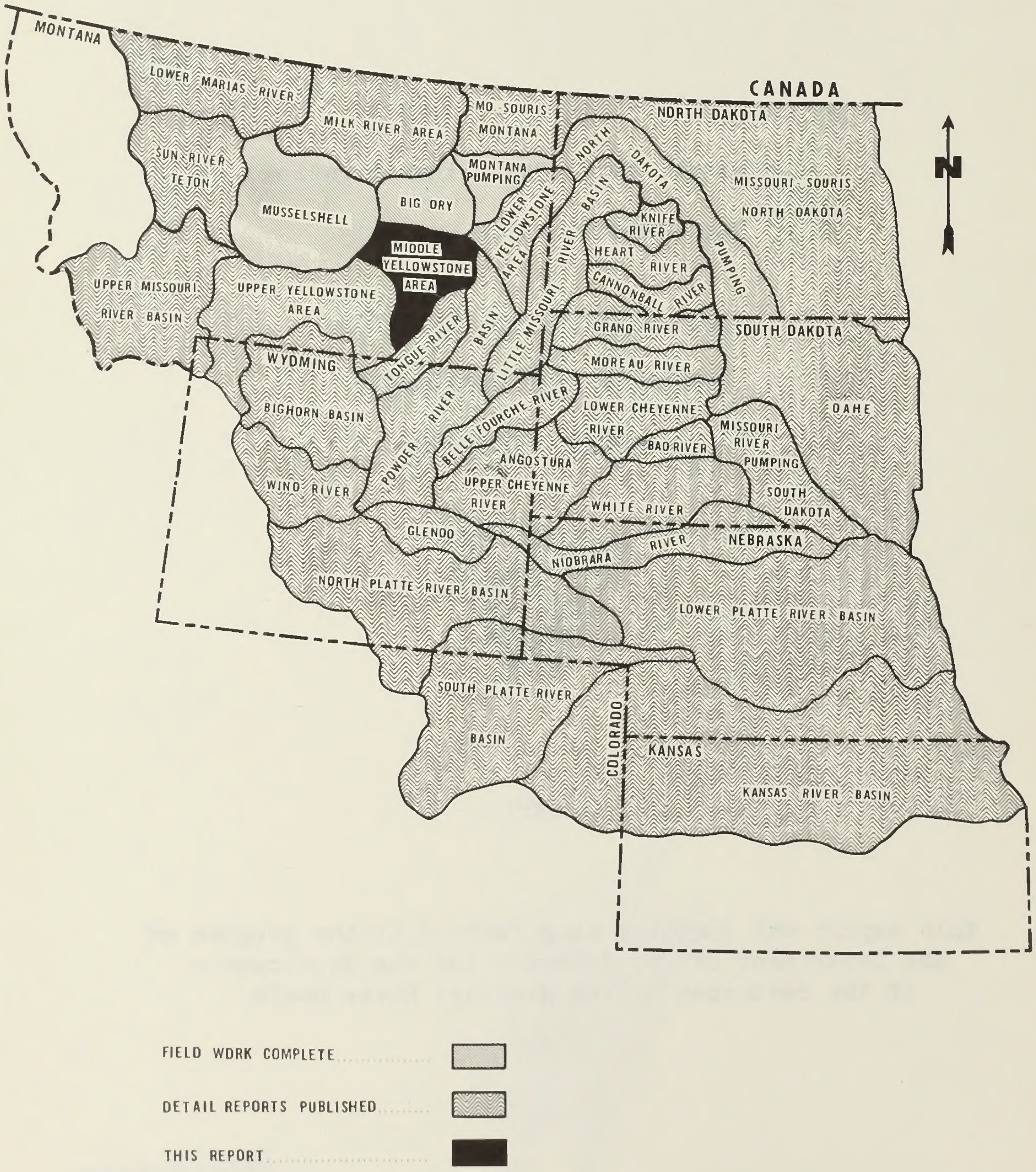

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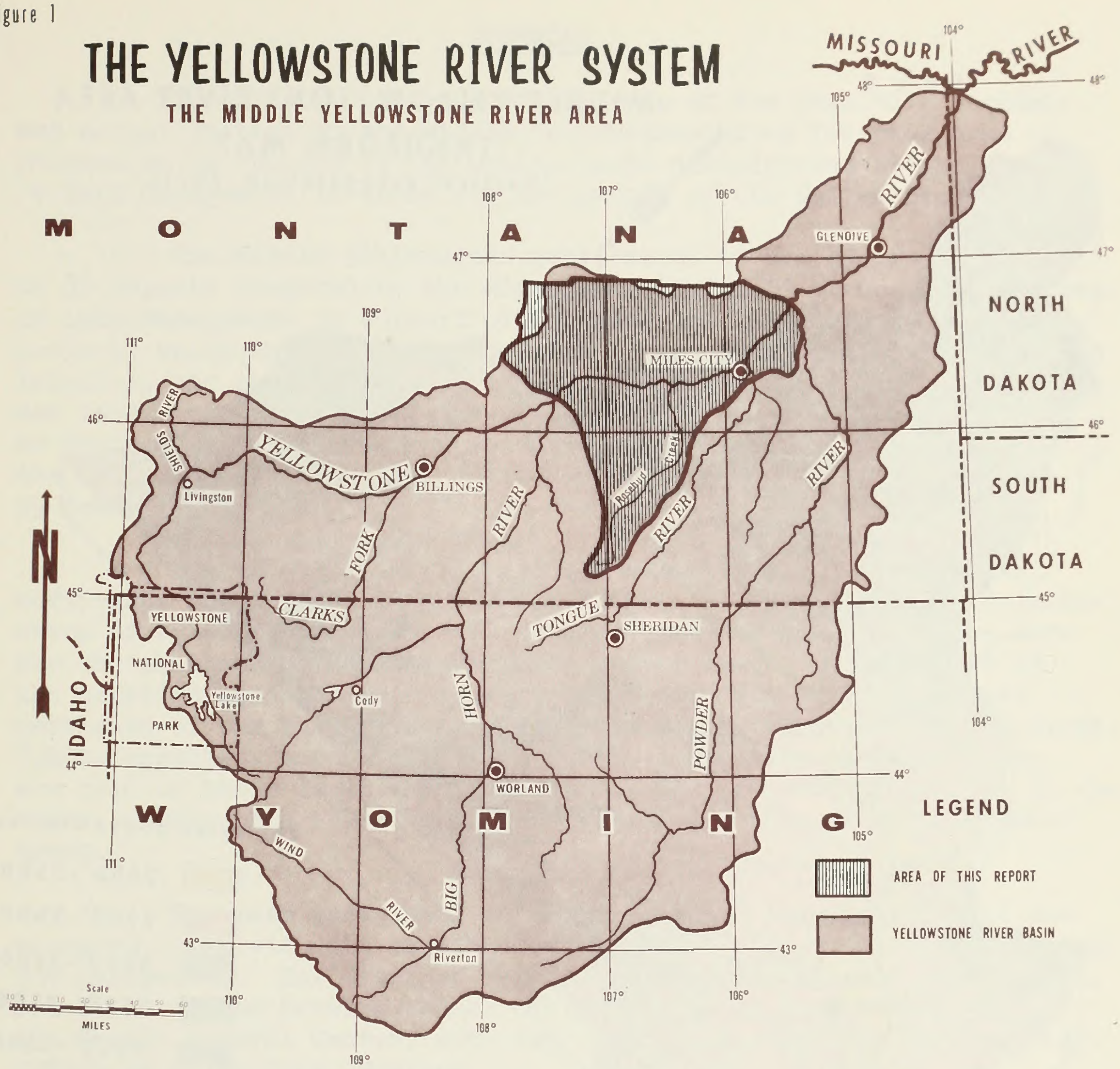
Figure 1



THE YELLOWSTONE RIVER SYSTEM

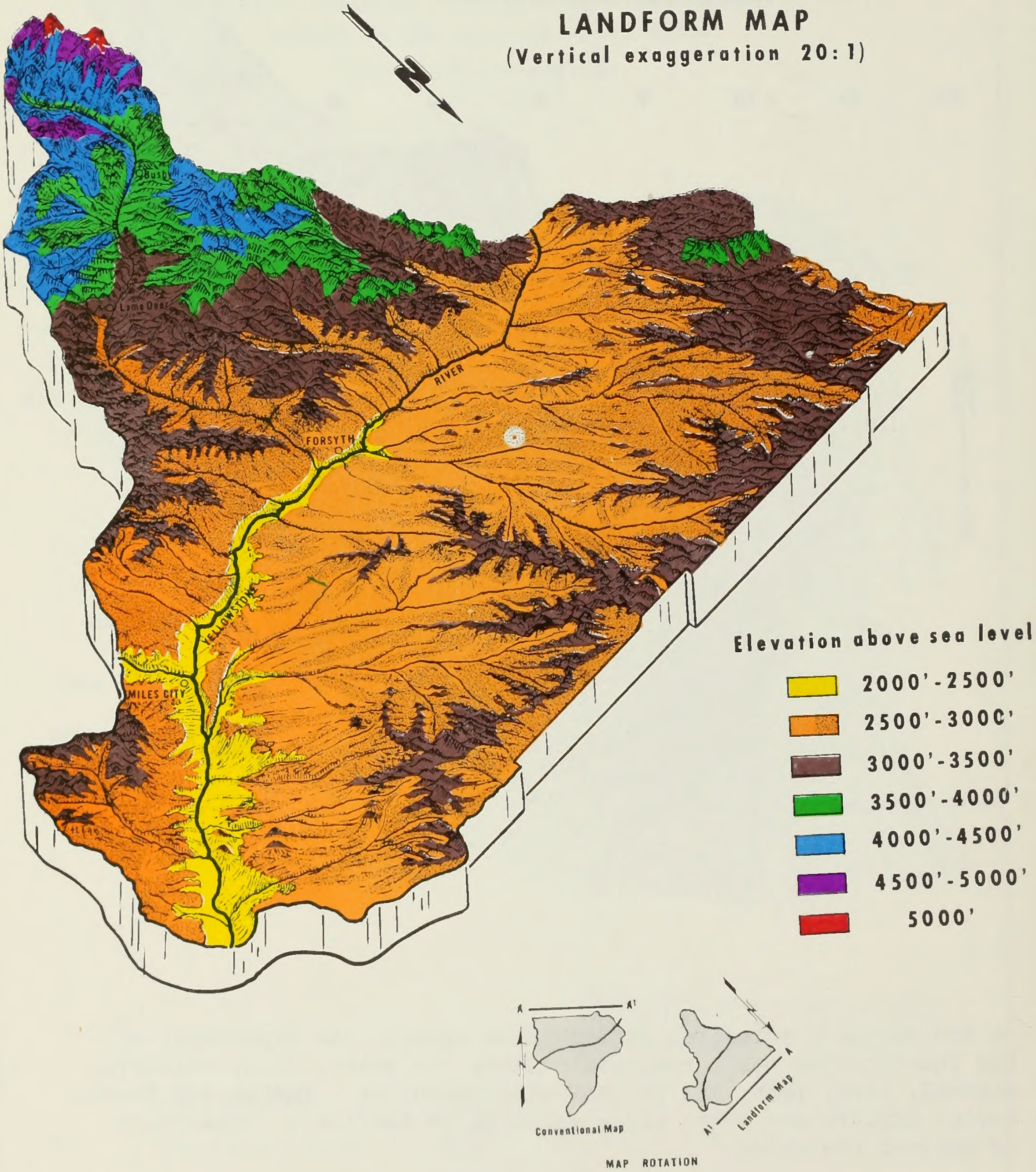
THE MIDDLE YELLOWSTONE RIVER AREA

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States - now and in the future.

Figure 2

MIDDLE YELLOWSTONE RIVER AREA
LANDFORM MAP
(Vertical exaggeration 20:1)



FOREWORD

This report presents an analysis of the physical, economic and social factors of the Middle Yellowstone River Drainage Area of Montana as it applies to the public lands administered by the Bureau of Land Management in trust for the people of the United States.

The Middle Yellowstone publication is the 33d in a series of 35 reports prepared by the Missouri Basin field group of the Bureau of Land Management in support of the Missouri Basin project. That project, which is a basin development program of the Department of the Interior, has its basic authority in the Flood Control Act of 1944 and is executed by the Secretary of the Interior through the Bureau of Reclamation as the construction agency. The Department, through the latter agency, finances Bureau of Land Management participation by transfer of funds.

Based on historic background and detailed field studies, sufficient information is presented in this report, to enable consideration of specific problems, and to permit recommendations to be made for the management and tenure of the public lands. The purpose of the detailed study of each tract is to direct its use in the best interests of the public, compatible with proper conservation practices. Public agencies, both federal and local, interested in these lands are told of their location, description, and prospective utility by two means, namely this report and the detailed accounts of each isolated tract.

For each individual tract of land, an inventory report was prepared, complete with maps, details of condition, and recommendations for management. The detailed reports, summarized in this publication, are filed in the Service Center of the Bureau of Land Management at the Denver Federal Center, with copies of each report in the District Office at Miles City, Montana.

The complete drainage basin of the Yellowstone River is so extensive that it was found expedient to present the discussion of its public lands by subbasin. Separate subbasin reports within the Yellowstone system have been published for the Wind River, Powder River, Big Horn Basin, the Lower Yellowstone, the Upper Yellowstone, and the Tongue River. Publication of the following report completes the series for the Yellowstone Drainage.

One objective in the writing of this report has been to demonstrate the long-term trend in soil and vegetative condition. For that reason, extensive use has been made of historical accounts and photographs. The journals of early explorers cover the area fairly well, beginning with Larocque in 1805, Captain William Clark in 1806, and extending to the 1860's. Following the era of the explorers, came the early-day photography and the land classification reports of the 1920's by the U. S. Geological Survey. Information contained in the earlier reports is presented in reasonable detail, to give the reader a basis for comparing the country in its undeveloped state, with conditions now prevailing.

The field inventory, analysis of data, and writing of this report were directed by Richard D. Burr, Supervisory Range Conservationist. The manuscript layout and preparation were the responsibility of secretaries Margaret Baugh and Joan Robinson. The maps were prepared by draftsman John L. Kovacs. Editing and technical assistance were provided by Eugene L. Schmidt, Chief, Office of River Basin Studies. Valuable assistance was rendered by the Bureau of Land Management District Offices at Miles City and Billings, Montana.

SUMMARY

The Middle Yellowstone River Area, in southeastern Montana, resembles an inverted triangle 120 miles across at the northern boundary, and tapering to about 18 miles across at the southern tip. Figure 1. From north to south the subbasin is 126 miles long. The Yellowstone River, a major tributary of the Missouri River, flows from west to east across the northern third of the area. Numerous intermittent creeks entering the river are minor contributors to the main stem flow. The Tongue River joins the Yellowstone River at Miles City, Montana.

Parts of six Montana counties, roughly totaling 4,585,000 acres, lie within the subbasin boundaries. The Bureau of Land Management administers approximately 344,000 acres, of which 298,000 are vacant public domain, and 46,000 acres are LU (Land Utilization) lands. LU lands are marginal farmlands used beyond their capability for agricultural production during the early part of this century, and purchased in the 1930's by the Federal Government under the Bankhead-Jones Farm Tenancy Act. Also within the subbasin are 360,000 acres in two separate Indian Reservations, the Northern Cheyenne and the Crow. The Fort Keogh Bird Refuge southwest of Miles City occupies 44,000 acres. State lands comprise about 200,000 acres. Private and miscellaneous public lands make up the remaining 3,637,000 acres.

The elevations of the Middle Yellowstone Area, north and south of the river, vary from 2500 to 4000 feet above sea level. The southern portion of the subbasin, however, averages slightly higher and the tip reaches 5000 feet elevation. Figure 2. The Yellowstone River marks the division between two very different types of topography. North of the river the terrain is predominantly level to rolling, rising gently from the river as a broad plain; scattered on its smooth surface are small areas of broken, rough country. Figure 3. Immediately south of the river the land is rough and broken, rising abruptly from the river valley as intricately dissected terrain with short steep intermittent drainages. Figure 4.

The Yellowstone River flows for 132 miles from the western boundary of the subbasin, two miles below the mouth of the Bighorn River, to the eastern boundary cutoff one mile above the Powder River.

The principal town and trade center is Miles City, with a population of 9,800. Forsyth, population 2,000, is the only other town of significant size. Lame Deer, with a population of 300 is the headquarters of the Northern Cheyenne Indian Reservation. Other villages and communities are scattered throughout the subbasin.

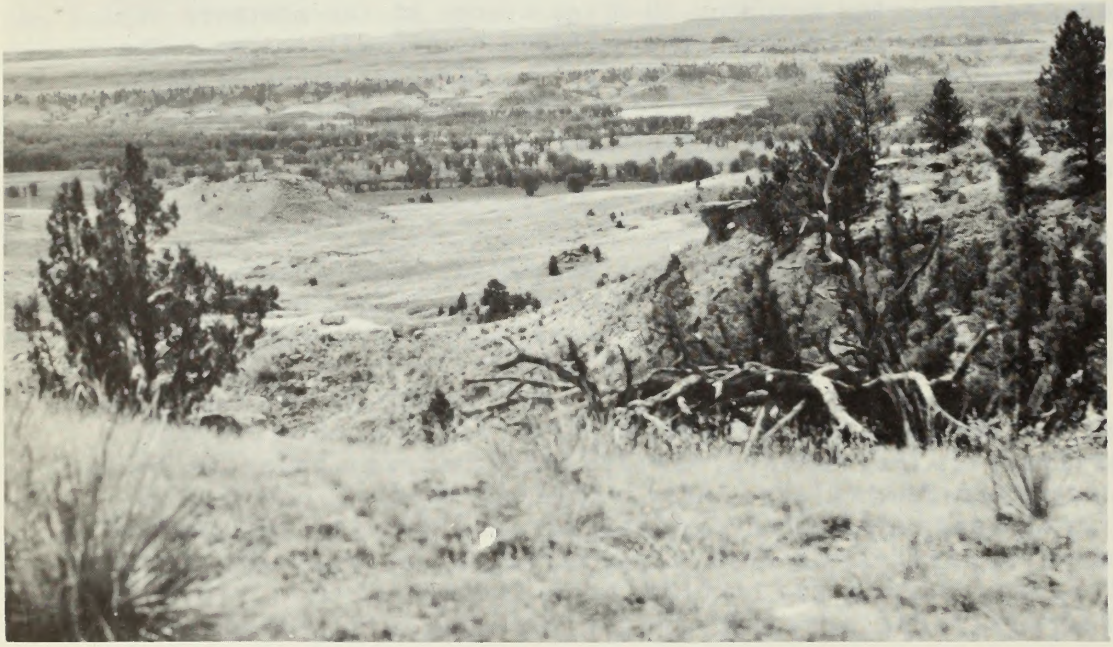


Figure 3 Looking north across the Yellowstone River to the open plains. The river, in mid-distance, is bordered by cottonwoods along its alluvial valley.

Vacant lands administered by the Bureau of Land Management are scattered; of the 298,000 acres of public domain in the subbasin, 223,000 acres lie north of the river and 75,000 acres to the south. Of the 46,000 acres of LU lands, 44,000 acres are in the extreme eastern part of the subbasin in Prairie and Custer Counties; the remaining 2,000 acres are in the extreme west, in Yellowstone County.

The public domain is used mainly for livestock grazing. The Yellowstone River divides the rangeland into two areas of generally different forage. North of the river, on the sloping plain, salt-tolerant Gardner saltbush is often associated with western wheatgrass and Sandberg bluegrass; this forage is preferred by sheep. South of the river, in the rugged terrain, western wheatgrass and bluebunch wheatgrass are dominant, and the native vegetation is more favorable to cattle.

Ecologically, 35 percent of the public lands were shown by the current study to be in "Excellent" vegetative condition, 48 percent in "Good" condition, 15 percent in "Fair" condition, and

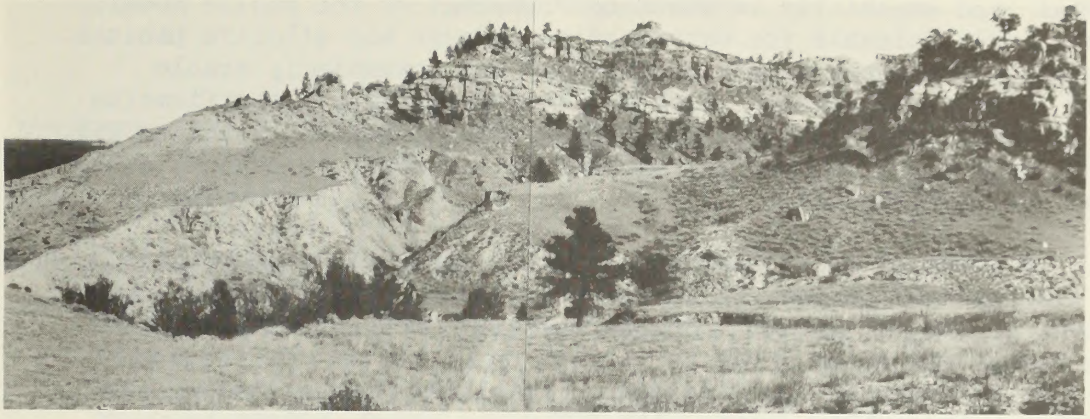


Figure 4 The rugged terrain south of the Yellowstone River was summed up tersely by Lieutenant Bradley scouting for General Terry, as "...a labyrinth of bald hills and deep precipitous ravines completely destitute of water." (U. S. Geological Survey Photograph)

the remaining 2 percent in "Poor" condition. Of the Land Utilization areas, 41 percent were shown to be in "Excellent" vegetative condition, 56 percent in "Good" condition, and the remaining 3 percent were divided between "Fair" and "Poor".

Most of the timber, ponderosa pine, lies south of the river, scattered along the ridges and forming a solid canopy at higher elevations; only 8,000 acres of the total of 270,000 acres of timber lie north of the Yellowstone River. Of the public domain, 1,000 acres are timbered, and much of it is noncommercial. The Northern Cheyenne Indian Reservation contains most of the commercial timber of the subbasin.

Soil productivity is good on 19 percent of the Middle Yellowstone subbasin. These soils are found on the river bottom and uplands; they support most of the irrigated and dry land farming. Most of the soils, 76 percent, have a low productive potential, due to either deep, heavy clay, or a shallow undeveloped profile. These lands have their principal value in livestock grazing and preservation of watershed. The remaining 5 percent of the soils is badlands.

An estimated 83 percent of the public domain in the Middle Yellowstone drainage is in land capability Class VII. Class VII is well suited to grazing, and timber production but requires careful management because of shallow or unstable soils or adverse topography. Lands in Class VI capability comprise 13 percent of the public domain; these have relatively deep soils with favorable topography and require only good grazing or timber management for continued productive use.

Class VIII land capability is found on 2 percent of the public domain; these are lands valuable for watershed management and wildlife habitat. The remaining 2 percent is distributed between potentially arable land and other miscellaneous classes. Land capability classification of the LU lands places 52 percent in Class VI, 43 percent in Class VII, with the remaining 5 percent distributed in Classes I through V; only 35 acres are in Class VIII.

A study of soil loss through water erosion on the public domain disclosed 68 percent to be in the "none to slight" class, and 32 percent in the "slight to moderate" class. On the LU lands, water erosion damage was rated "none to slight" on 91 percent of the area and "slight to moderate" on 9 percent. Accelerated wind erosion was negligible on the public domain with 357 acres rated "slight to moderate", and the remainder as "none to slight".

Two general land patterns occur in the public domain of the Middle Yellowstone subbasin; areas of concentration and isolated tracts. Within the areas of concentration were 172,000 acres inventoried by a comprehensive examination that included the intermingled lands of other ownership.

Four hundred and forty-six isolated tracts were inventoried. (The results of the inventory are shown in Appendix A, where each tract is described.) Two hundred and sixty-four of the tracts, containing 93,000 acres were characterized by values which make them best suited to retention and continued management in public ownership as part of the public domain. One hundred and eighty-two tracts containing 31,000 acres had values indicating they were better suited to private management.

The Middle Yellowstone Area is within one of the nation's surplus recreation areas, where potential for vastly increased recreational use abounds. Eighteen thousand of the 93,000 acres in the retention category have specific recreational and wildlife values. These public lands are of growing importance from the standpoint of both functions. They are a primary source of "open space" for use by expanding populations. On most tracts the recreation and fish and wildlife values of public lands are found in combination with other significant resources.

Land tenure recommendations are not made for the 46,000 acres of Land Utilization tracts acquired under the Bankhead-Jones Act; that act segregates them from provisions of the public land laws, except for exchange, by which transfers are normally made.

Classification recommendations made in this report do not constitute an administrative determination for land retention or disposal. An authorized official of the Bureau of Land Management must review and approve all land use proposals before action is taken on individual applications and before any change in land status occurs.

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THE MIDDLE YELLOWSTONE RIVER AREA

GENERAL DESCRIPTION

Location, Size, and Natural Features

The Middle Yellowstone Area of 7,200 square miles is triangular-shaped, measuring 120 miles across its northern border and extending for 126 miles to the south. The Yellowstone River, flowing through the wide northern part of the subbasin divides the level-to-rolling terrain north of the river from the rough and more broken country to the south.

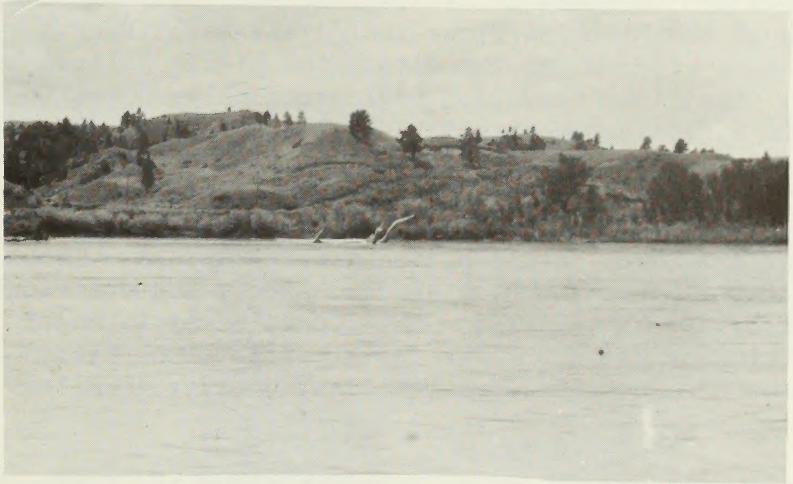


Figure 5 Typical gentle hills along the north side of the Yellowstone River.

Because of the triangular shape of the subbasin, there is no true southern boundary. To the west, starting from the southern tip, the Middle Yellowstone Area boundary is formed by the divide between Rosebud Creek and the Little Bighorn River. It continues northward between Sarpy and Tullock Creeks, crossing the Yellowstone River two miles below the mouth of the Bighorn River, and runs to the Musselshell River which forms the remainder of the western boundary. The northern boundary follows eastward along the Garfield-Rosebud County line to Custer Creek where the north and the east watersheds of Custer Creek continue as a boundary to the Yellowstone River. The northeast corner of the subbasin lies on the Yellowstone River about one mile above the mouth of the Powder River. From that point, the Tongue River-Rosebud Creek Divide forms its principal eastern boundary.

Most of Rosebud, Custer and Treasure Counties lie in the Middle Yellowstone subbasin; smaller areas of Yellowstone, Prairie, and Bighorn Counties are also included. The total drainage area is 4,585,000 acres.

Within the subbasin, the Bureau of Land Management administers approximately 298,000 acres of public domain; Land Utilization tracts, acquired by the Federal Government under the Bankhead-Jones Act in the early 1930's comprise an additional 46,000 acres. The Northern Cheyenne and Crow Indian Reservations occupy 360,000 acres at the southern end of the subbasin. On the eastern boundary, southwest of Miles City, the Fort Keogh National Bird Refuge contains 44,000 acres; state-owned lands total 200,000 acres.

The Yellowstone River flows for 670 miles from its source, just south of the southern boundary of Yellowstone National Park in Wyoming,to its mouth on the Missouri River inside the North Dakota state line; 132 of these river miles run within the Middle Yellowstone subbasin. Figure 5. The river elevation drops gradually, averaging 5 feet per mile, from 2,800 feet near the Bighorn River on the western boundary, to 2,150 feet at a point one mile above the Powder River on the eastern boundary. Tributaries entering from the north are Sunday, Little Porcupine, Muggins, and Alkali Creeks; from the south the tributaries are Sarpy, Armells, and Rosebud Creeks. These tributaries are all intermittent, except Rosebud Creek, and contribute little to the volume of the Yellowstone. The Tongue River (a major river covered in a separate report) flows for about 16 miles within the Middle Yellowstone Area to enter the Yellowstone River at Miles City.

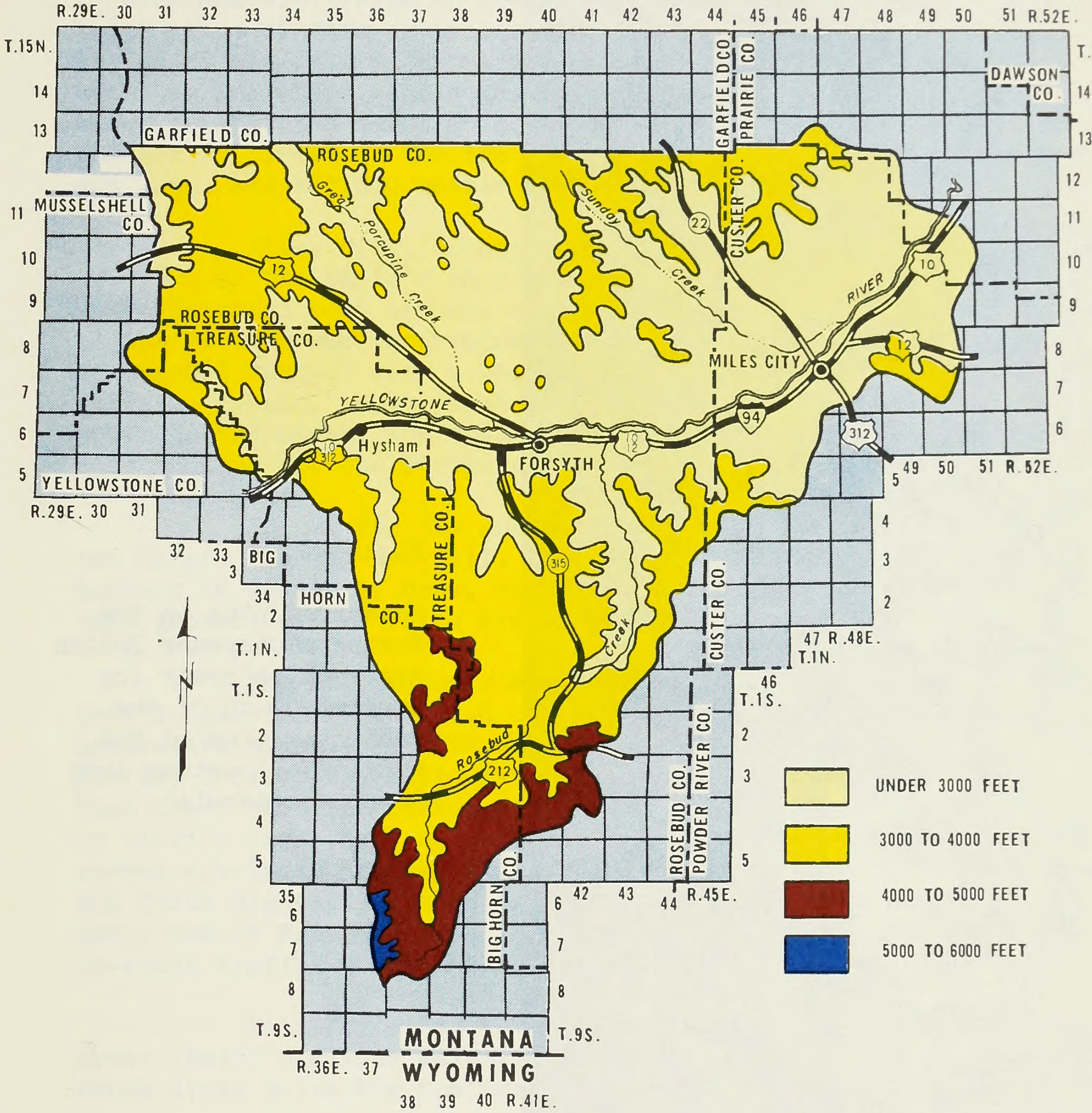
An arbitrary enlargement of the subbasin along the northern boundary includes 125,000 acres of the adjoining Musselshell drainage. Along the northern boundary, another small part, aggregating about 70,000 acres, drains directly into the Missouri River.

Elevations above sea level within the subbasin range from 2,500 to 4,000 feet except for a small area at the extreme southern tip that attains 5,200 feet. Figure 6. The Yellowstone River divides the subbasin topographically. North of the river, level to rolling land gradually rises to higher elevations. South of the river, changes in elevation are more abrupt, beginning with steep, rugged slopes at the river banks rising to a rough and broken type of country.

The main source of commercial timber in the subbasin is on the Northern Cheyenne Indian Reservation. Figure 7. Ponderosa pine occurs generally south of the river in scattered stands on the higher elevations and ridges. Cottonwoods and green ash, with an understory of wild rose and buffaloberry grow along the rivers and creeks.

GENERAL ELEVATIONS

Figure 6



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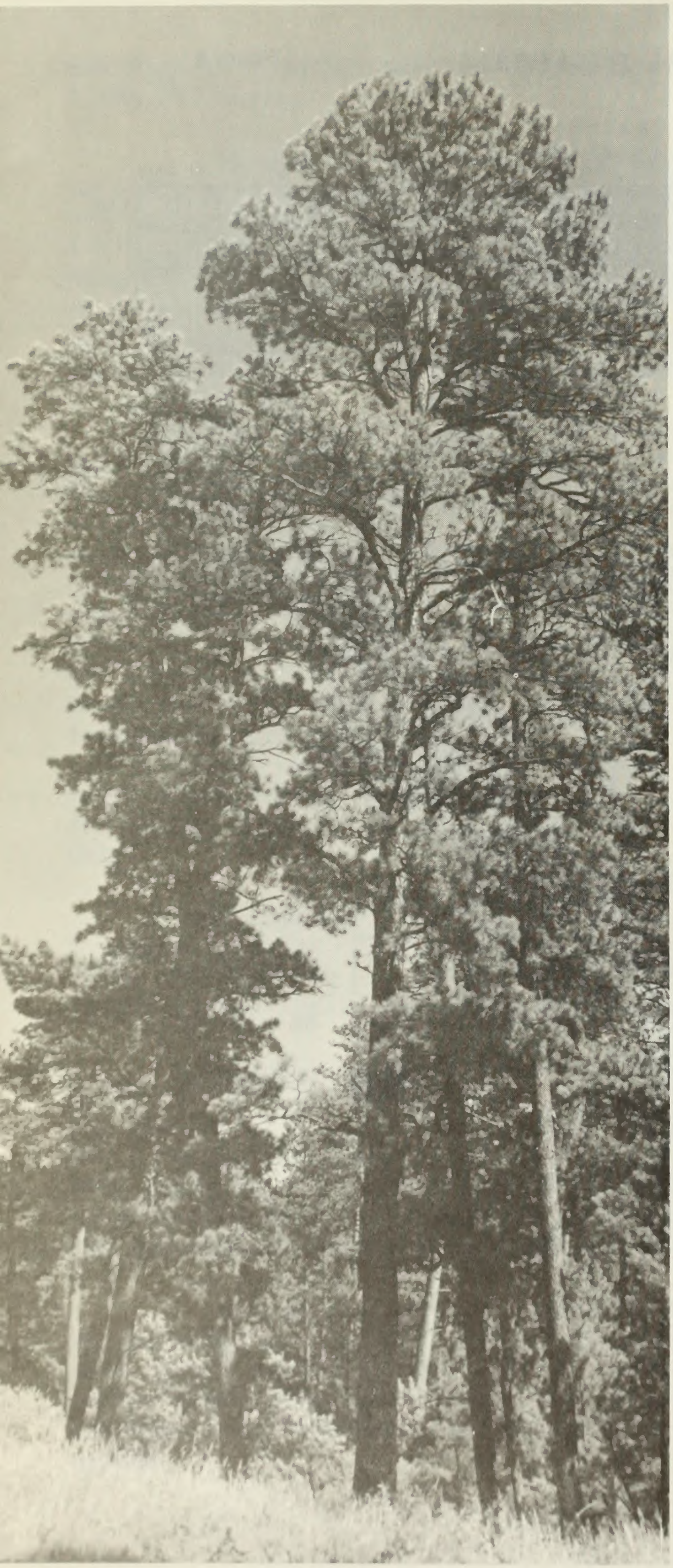


Figure 7

Ponderosa pine on the Northern Cheyenne Indian Reservation ready for harvest; much of the ponderosa pine in the Middle Yellowstone Area is non-commercial.

Agriculture is the backbone of the economy. Using data for Rosebud, Treasure, and Custer Counties (most of their acreage being within the Middle Yellowstone Area) approximately 55,000 acres of cropland are irrigated and 175,000 acres are dryland. The approximate value of farm crops for the three counties is $3.5 million. Irrigated and dryland crops include alfalfa hay, winter wheat, barley, oats, spring wheat, and sugar beets. Range production of cattle and sheep constitutes about an equal share of the agricultural economy. Numbers of livestock for the years 1964 to 1966 averaged 82,000 sheep and lambs and 177,000 cattle and calves.

Miles City, county seat of Custer County, with a population of 9,800 is the basin's major trade center and only city. It is a range-oriented town without artificial stimulation, that retains many of the earlier ways and values of ranch life. Forsyth, county seat of Rosebud County, with a population of 2,000, is the next largest center. Hysham, county seat of Treasure County, has a population of 500. To the south, the town of Lame Deer with 300 people is the headquarters for the Northern Cheyenne Indian Reservation.

Income for the subbasin from tourists and recreation is not large. During the fall, however, the country area attracts many hunters in search of deer, antelope, pheasant, sage grouse, and sharp-tail grouse, all of which are plentiful.

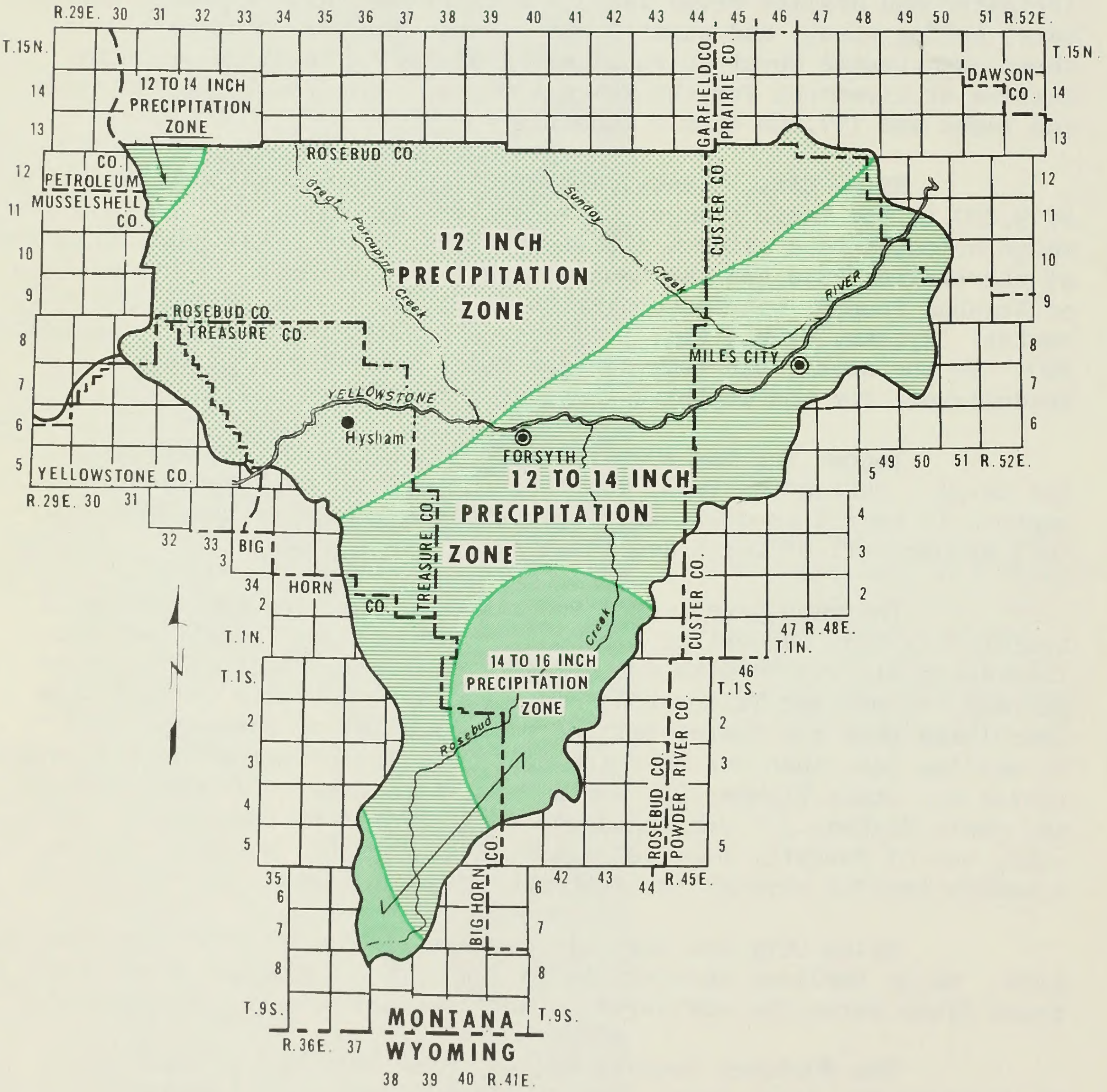
The main paved roads and highways are adequate for the traffic carried. Gravelled secondary roads are good in all weather. Interstate Highway 94 with an average traffic flow of 1,250 vehicles per day follows the Yellowstone River Valley. U.S. 212 through Lame Deer leads past the Custer Battlefield; paralleling Interstate 94 it carries less than one-half the traffic. The principal north-south routes are State Highway 22, north from Miles City to Jordan, Montana and State Highway 315 running south from Forsyth to Lame Deer. Northwest, out of Forsyth, U.S. 12 continues to Roundup, Montana. North-to-south traffic through the subbasin is mostly local.

Miles City has the only commercial airport in the report area. Major buslines maintain schedules to the principal towns and truck lines serve the scattered communities throughout the subbasin.

The Northern Pacific Railway parallels the Yellowstone River along its south bank. The St. Paul, Chicago, Milwaukee and Pacific Railroad also parallels the river to Forsyth where it departs from the river valley and heads northwest. About 5 miles west of Forsyth, a spur of the Northern Pacific Railway runs south to Colstrip, a major coal-producing town.

Figure 8

ANNUAL PRECIPITATION



Climate

The average annual precipitation is 12 to 16 inches. Figure 8. Most of this amount (9 to 10 inches) falls as rain during the growing season - at the most effective period for crop and forage production. Figure 9 shows this favorable pattern of rainfall and gives the annual total.

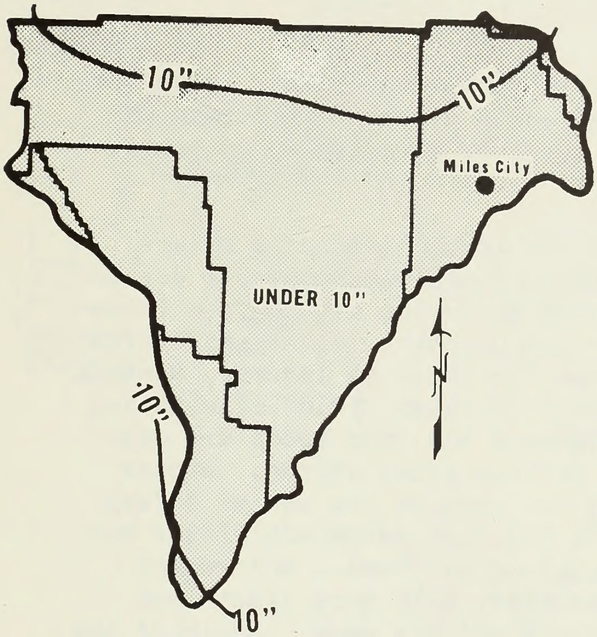


Figure 9 Warm Season Precipitation
April-September

A steppe-like, stable cover of native perennial short and mid-grasses develops at this latitude (approximately 47°N.); certain soils favor mixed shrubs and grass. Improper grazing or drouth may temporarily alter the grasslands into a cover of shrubs and grass, even down to annual plants. Drouths take place at intervals, and may occur as often as one year in every four.

Because of favorable water relationships in the rocky crevices and interstices of the rocks in the rugged terrain so common south of the Yellowstone River, the shallow soils support ponderosa pine as well as perennial grasses. In a small zone with higher annual precipitation of 14 to 16 inches, the pine reaches commercial size and is logged. Approximately 95 percent of the subbasin or 4.2 million acres, supports a form of native vegetation best adapted to the uncertainties of weather, and to the many and occasionally disastrous climatic fluctuations.

The growing season varies with elevation. Figure 10. The lowest elevations, along the Yellowstone River valley, have the longest frost-free periods, extending more than four months; this compares favorably with most of the United States at the same latitude. Crops must be hardy and cold resistant, but also able to withstand heat and dryness. Of the suitable crops, alfalfa hay and winter wheat, aggregating 115,000 acres make up twice the acreage of all other major crops combined. The latter include barley, wild hay, oats, spring wheat, sugar beets, and corn.

In the northeast the limited rainfall is sufficient to raise small grain crops by summer fallowing on soils that are level, moderately fertile, and relatively deep. In this practice, winter wheat is planted during fall months on the summer fallow fields; the seed germinates on the accumulated moisture of summer, lies dormant over the winter and matures on the following year's rainfall. Fields managed in this way produce a crop every other year.

Wind erosion can be a problem on the bare level soils. The usual protective practice is to alternate narrow strips of crop and fallow lands oriented at right angles to the prevailing wind. These strips are fallowed in rotation.

Escaping the limitations of the semi-arid climate in another way, crop lands on level, deep alluvial soils adjacent to permanent streams, are often irrigated from the river by diversions and pumps. Figure 11.

The climate of the Middle Yellowstone Subbasin is severe. The summers are hot and winters are cold. Snows accumulate to depths of 30 to 40 inches. This snow cover remains on the ground from three to four months, a vital protection for the dormant plants against the intense cold of winter. The maximum low, recorded at Ingomar, Montana was - 55°F.. High winds often bare the cultivated fields eliminating the insulating effect of the snow. Highways and farm roads are usually cleared of snow except for short periods after storms. Winter livestock management is greatly simplified through the use of modern equipment. Livestock are maintained on the open range all winter but they are usually fed with purchased supplemental feed. The rugged broken terrain south of the Yellowstone River with more timber and brush gives winter protection to livestock and big game. North of the river, badlands on the extreme east and west, and some broken lands between give animals partial relief during winter blizzards.

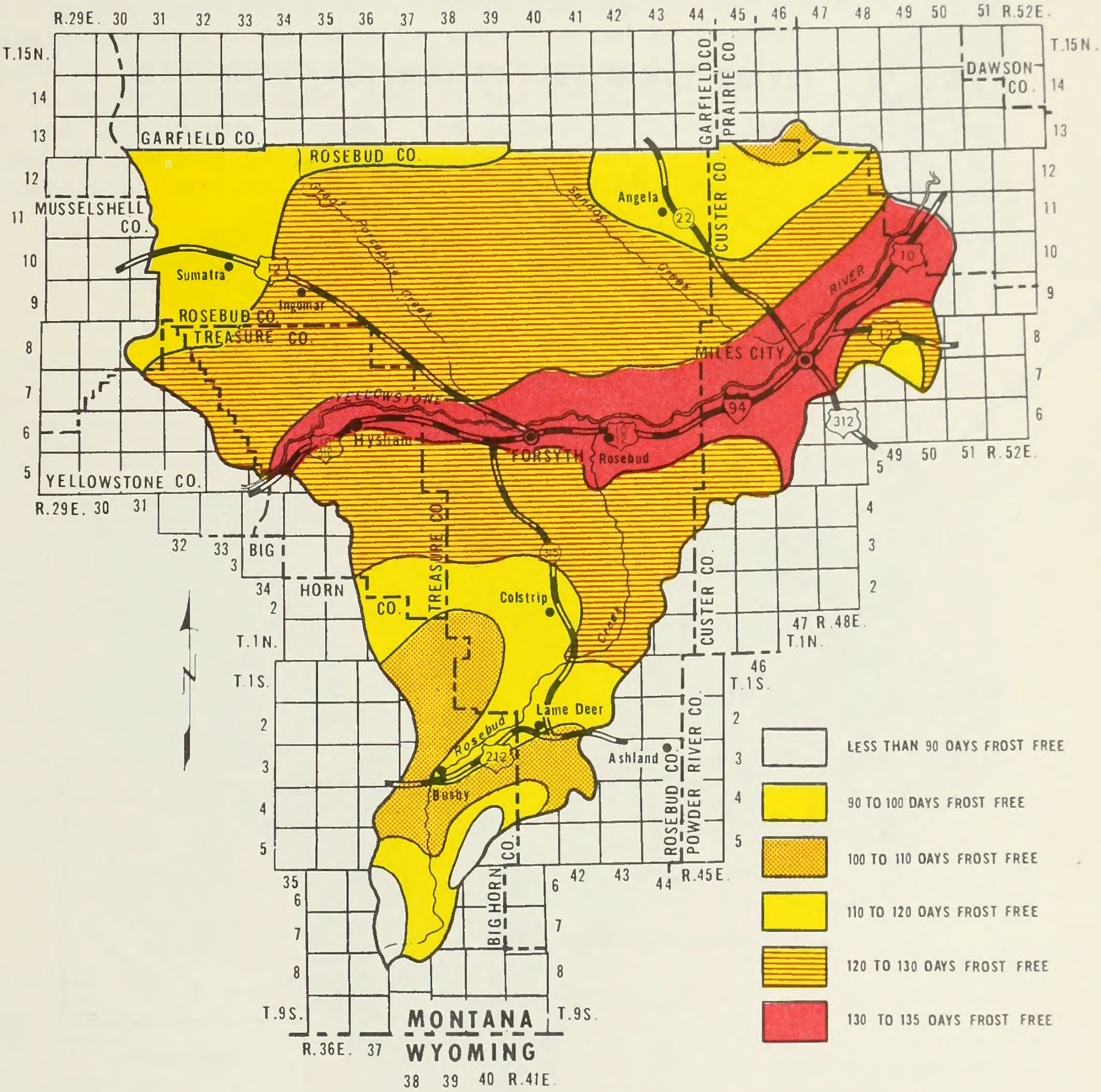
Thunderstorms are frequent, often accompanied by hail. Three to four hailstorms are expected each summer, and damage runs high. Crops are often destroyed and damage to buildings and automobiles is not uncommon.

In summary, the semi-arid climate of the area is characterized by extremes of temperature both summer and winter. These extremes are moderated by relatively low humidity and a preponderance of clear days. In the spring and fall the days are clear and cool, with bright sunshine. Grasslands and cultivated dryland crops adapted to the area are more than normally productive because most of the precipitation occurs during the effective growing season.

Figure 10

GROWING PERIODS

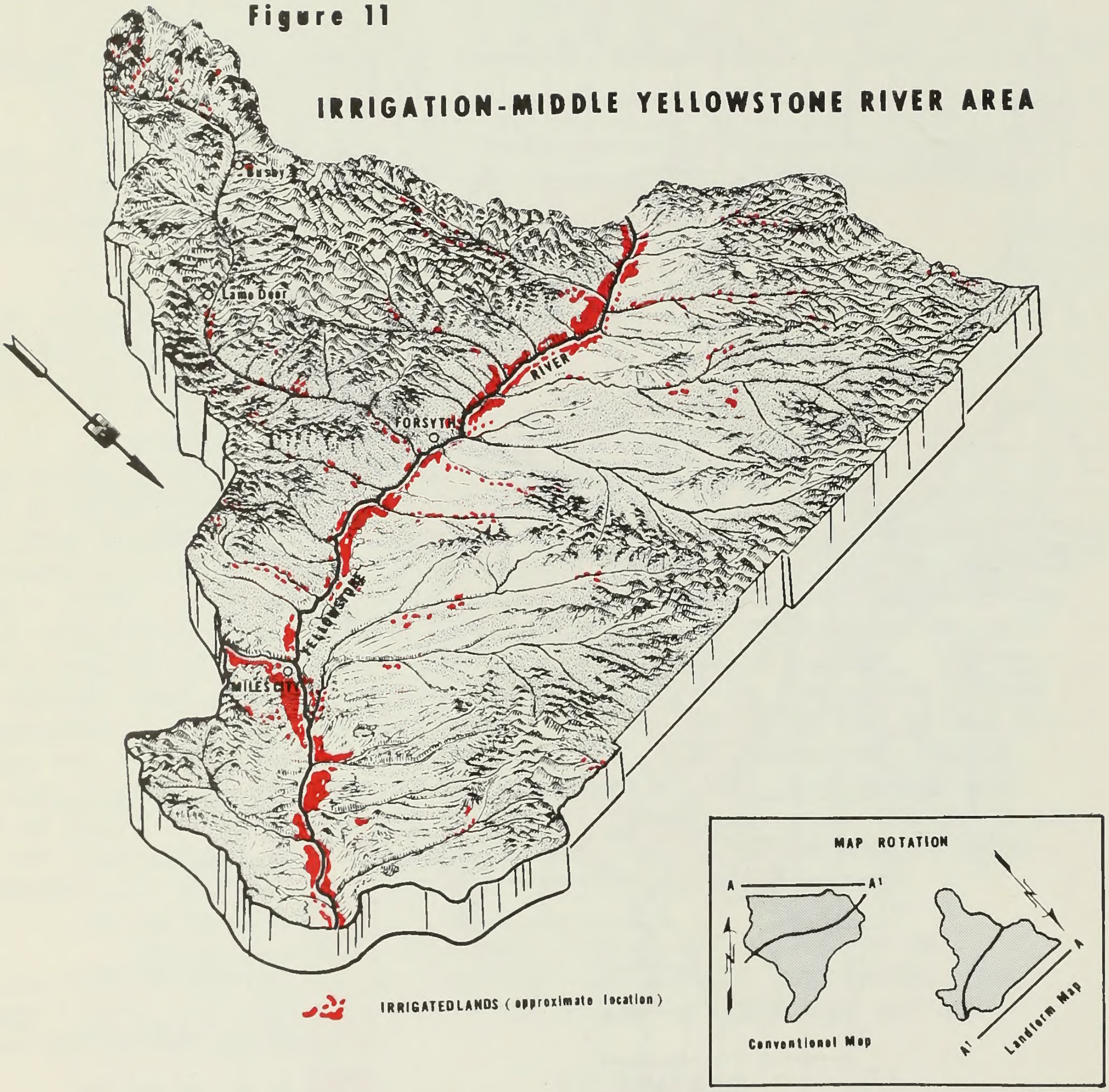
(Days Frost Free)



J.L.K.

Figure 11

IRRIGATION-MIDDLE YELLOWSTONE RIVER AREA



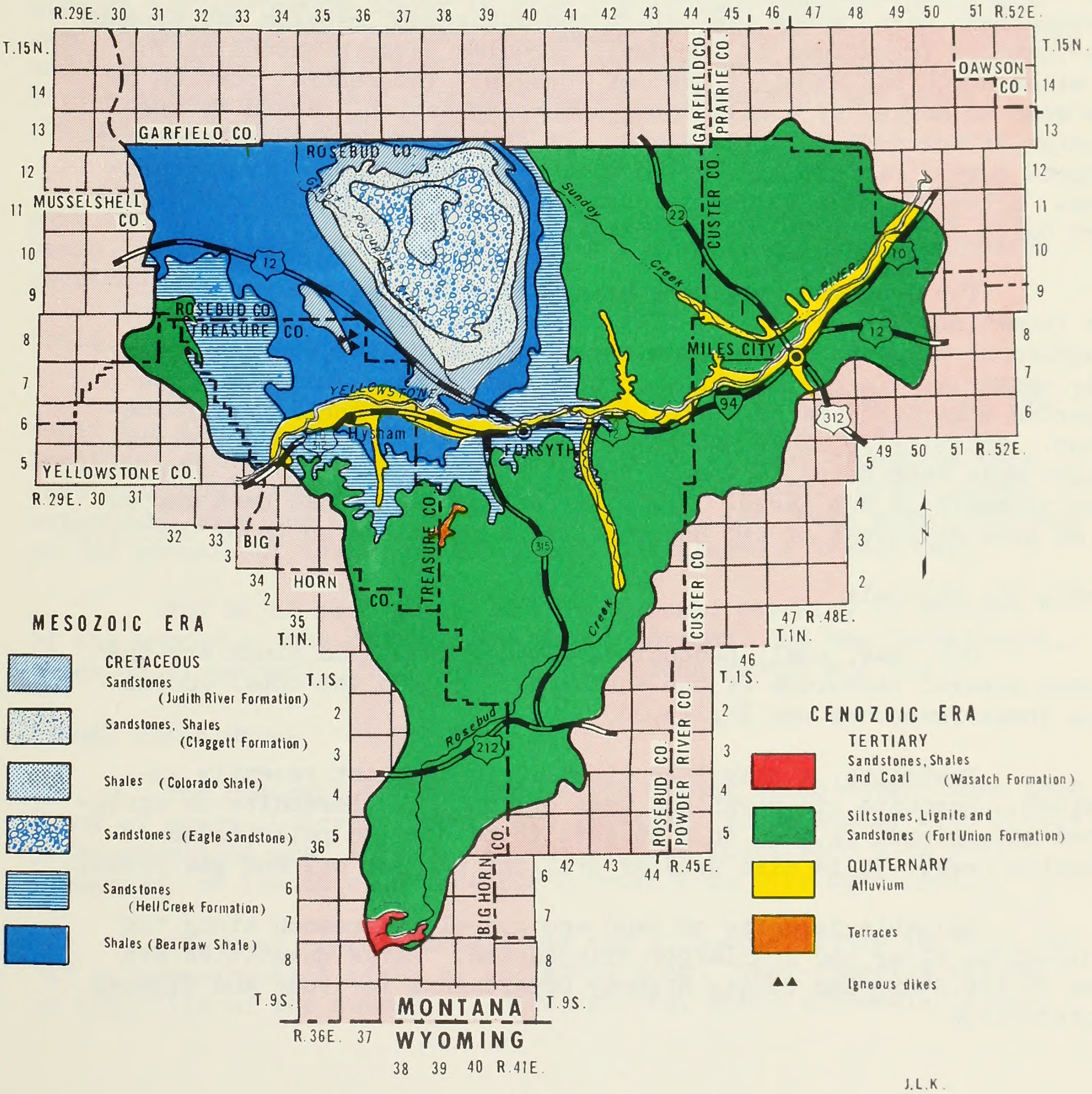
Geology

The Middle Yellowstone River Area is entirely within the Great Plains Province. It lies along the western boundary of the province and immediately to the north and east of the Middle Rocky Mountain Province. The area is characterized by rolling prairie topography in the north, river "breaks" along the Yellowstone River and its major tributaries, and, to the south, well dissected table land and interstream uplands. The latter is particularly true of the Indian reservation land, where the larger valleys frequently are bordered with vertical cliffs of red and buff-colored sandstone.

GEOLOGICAL MAP

Figure 12

BASED ON GEOLOGICAL MAP OF MONTANA U.S. GEOLOGICAL SURVEY - 1955.



J.L.K.

It is in this southern area where the relief between the valleys and uplands is greatest -- in some areas being as much as 1,300 to 1,500 feet. The highest point is a summit in the Rosebud Mountains, reaching an altitude of 5,205 feet. Nine miles due west, at Lodge Grass, the elevation is 3,400 feet. North of the Yellowstone River, the elevations generally are between 2,700 and 3,200 feet above sea level. In the northwest corner of the area, a few points are as high as 3,500 to 3,700 feet.

With one significant exception, the Middle Yellowstone River Area is covered with sedimentary-type rocks. About ten miles north of Hysham there are one or two small dikes of extrusive igneous rocks emplaced during Tertiary time. Figure 12. The sedimentary rocks range in age from the oldest middle Cretaceous Colorado shale, exposed in the Porcupine Dome, to the youngest Tertiary Wasatch formation in the extreme southern tip of the area. The dome is located in the northwestern part, where its uplift and subsequent erosion has exposed pre-Tertiary formations in a roughly circular pattern extending for 50 miles north and 25 miles west of Forsyth. The central portion of the dome is marked by a mild topographic depression, caused by the erosion of the soft Colorado shale. It is further marked by an intermittent outer "rim" formed by the more resistant Judith River formation. Elsewhere, the Middle Yellowstone River area is covered by the Fort Union formation of early Tertiary age.

The geologic structure of the area is relatively simple. The formations are relatively flat in the northeast, central, and southern areas, with dips seldom exceeding one or two degrees, generally easterly. In the northwest, the uplift of the Porcupine Dome imparted moderate dips of up to ten degrees to the encircling formations. Faulting is minor and quite localized. A few discontinuous faults have been noted in the Porcupine Dome but their total displacement probably is not large. A similar set of faults has been mapped in an area northwest of old Hopsonville, a few miles north of Colstrip.

Mining and Minerals

Oil, gas, coal, bentonite, sand, gravel, and stone are the common mineral resources of the subbasin. In 1966 the total income from these resources was $3,215,000.

Bentonite, a clay-like mineral, is the most recently exploited. Deposits lie north and west of Vananda. Bentonite is strip-mined and shipped in bulk to Minnesota to be used in pelletizing taconite ores. It is also used as drilling mud for oil and gas wells.

Valuable deposits of sand and gravel are common along the Yellowstone River and its larger tributaries. Large quantities are used by the State and County Highway Departments for road and highway construction.

Oil and gas are produced near Sumatra in the northwest section of the subbasin. Since 1960 oil production has declined steadily, nevertheless it adds about 2.5 million dollars annually to the economy. Gas production is dropping along with oil. Geologic formations are favorable in the subbasin and the oil and gas potential remains mainly unexplored.

Production of coal statewide dropped to an all-time low by 1967. In 1966 the Middle Yellowstone Subbasin ranked fifth in the state in coal production. Present plans for an immediate increase in the use of coal for thermoelectric power raises its importance in the economic values of the future but new technological advances offer even greater promise. Sub-bituminous coal in the subbasin is almost unlimited. It can provide a source for the manufacture of liquid hydrocarbons, pipeline gas, and other products. The water necessary for petrochemical production appears to be available. The highest quality ground water is from the terrace gravels; it is now used in homes and for irrigation. Water is abundant for both industry and agriculture. A processing plant for synthetic hydrocarbons will have a strong social and economic impact. Investment may reach 300 million to 400 million dollars.

Thus, the mineral industry which has played such a large part in the development of Montana has genuine promise for the subbasin. For further details see Minerals discussion in the Economics section.

Soils

Cultivable soils make up only a small percentage of the subbasin but are important from an economic standpoint. Figure 13. Immature, shallow soils predominate. Almost without exception they have developed from sedimentary clays and sandstones. These parent materials, plus the effects of topography and age, were most important in the genesis of these soils; climate has played a lesser part.

The major soil groups are the Azonal, covering 81 percent of the subbasin; the Zonals, covering 8 percent; and the Intrazonals, covering 11 percent. Soil types within these groups are few.

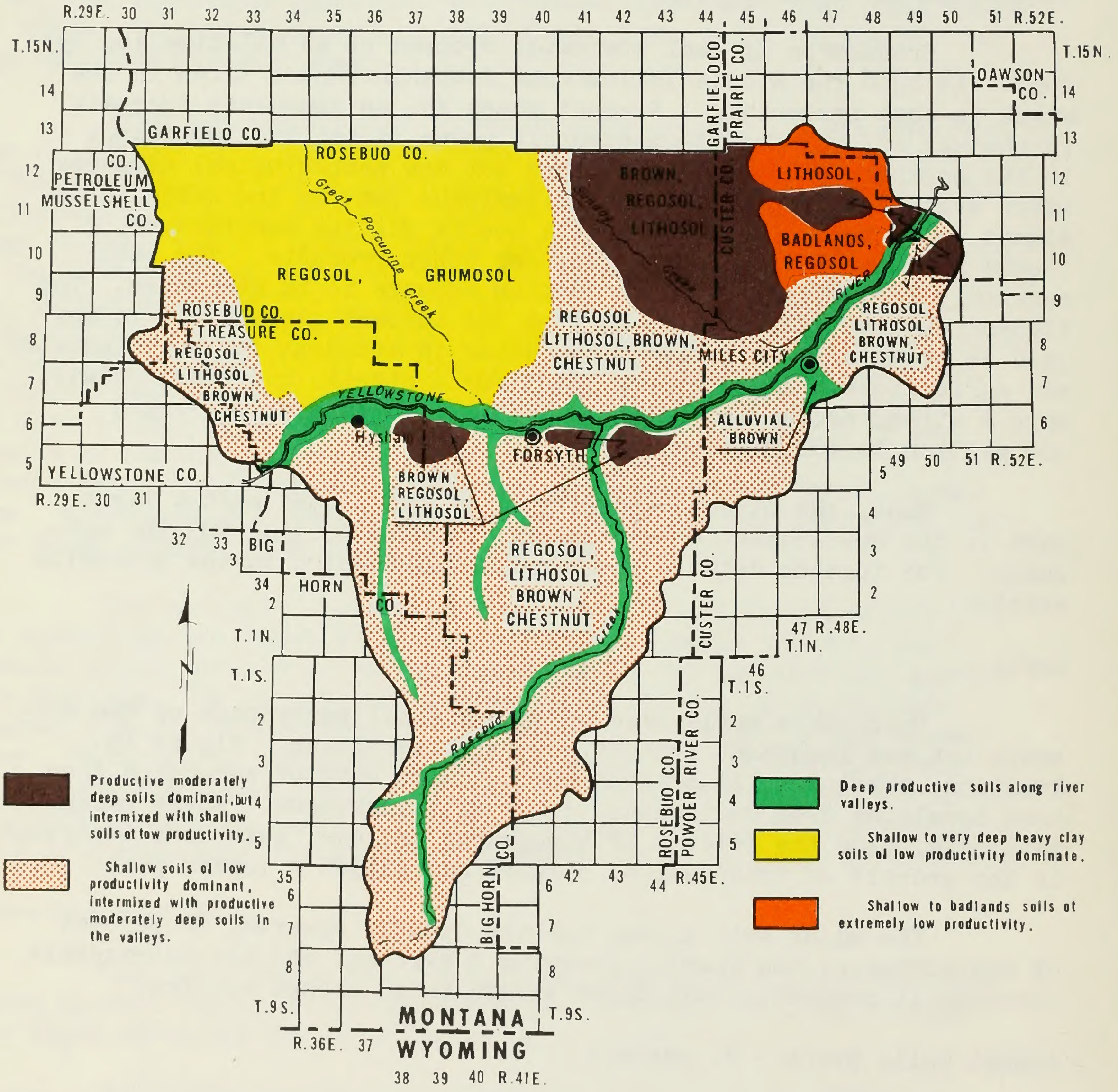
Azonal Soils Group - 81 percent

The dominant soils group is the Azonal which covers more than 8 out of every 10 acres. These are immature, young soils, with little or no developed profile because soil erosion keeps pace with soil formation, or insufficient age for a profile to have developed.

The most common Azonals are the lithosols, soils in which the "A" or upper horizon rests on resistant rock. They comprise one-half of the soils of the subbasin. Steep slopes, where lithosols often

Figure 13

SOILS MAP


R.29E. 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 R.52E.
T.15N.
GARFIELD CO.
ROSEBUD CO.
PETROLEUM CO.
MUSSELSHELL CO.
GARFIELD CO.
PRAIRIE CO.
CUSTER CO.
DAWSON CO.
Great Porcupine Creek
REGOSOL, GRUMOSOL
BROWN, REGOSOL, LITHOSOL
LITHOSOL,
BADLANDS, REGOSOL
ROSEBUD CO.
TREASURE CO.
REGOSOL, LITHOSOL, BROWN, CHESTNUT
REGOSOL, LITHOSOL, BROWN, CHESTNUT
REGOSOL, LITHOSOL, BROWN, CHESTNUT
MILES CITY
RIVER
YELLOWSTONE
Hysham
FORSYTH
ALLUVIAL, BROWN
BROWN, REGOSOL, LITHOSOL
REGOSOL, LITHOSOL, BROWN, CHESTNUT
Rosebud Creek
YELLOWSTONE CO.
BIG HORN CO.
CUSTER CO.
POWDER RIVER CO.
ROSEBUD CO.
BIG HORN CO.
T.1N.
T.1S.
R.48E.
R.45E.
T.9S.
MONTANA
WYOMING
R.36E. 37 38 39 40 R.41E.
N
Productive moderately deep soils dominant, but intermixed with shallow soils of low productivity.
Shallow soils of low productivity dominant, intermixed with productive moderately deep soils in the valleys.
Deep productive soils along river valleys.
Shallow to very deep heavy clay soils of low productivity dominate.
Shallow to badlands soils of extremely low productivity.

develop, perpetuate immaturity because the soil material is eroded away as it forms, which is true of much of the rugged broken country of the basin. Rock hardness also determines the rate of weathering, with the harder rocks weathering more slowly and prolonging immaturity.

On the ridges and hills, deep cracks in the parent material of the Azonals support ponderosa pine. Less steep, rocky slopes, and the valleys which have filled with soil material brought down by frost action and gravity, support grasses and shrubs. These pine-covered, bright red and yellow soils produce cover and forage for big game and livestock.

Another of the Azonal soils group (the regosols, figure 14) make up approximately 25 percent of the subbasin. Similar to the lithosols, they develop over the surface of unconsolidated materials, including sand dunes, gravel deposits, or soft rock such as sandstone and mudstone. Regosols may be immature because of an insufficient time lapse for their full development, or as happens with the lithosols, the developing soil erodes as fast as it forms. Most of the regosols are on privately owned land. They support vegetation important to livestock grazing. Both regosols and lithosols are low in organic matter.

The Alluvial soils, also in the Azonal Soils Group, cover about 6 percent of the Middle Yellowstone subbasin. Alluvial soils have a weakly developed profile, are mostly deep, and come from parent material deposited by water. Fertility is usually high. These soils tend to be coarse textured next to the river; further away, on the outer edge of the flood plain, they are fine textured. They are immature because of being reburied again and again before a mature profile develops. The level, fertile, deep and productive alluvial soils concentrated along permanent streams make up most of the irrigated lands in the Middle Yellowstone subbasin.

Zonal Soils Group - 8 percent

Zonal soils are fully developed mature soils, in which there will be no further profile change, despite the continued action of soil-forming influences.

Brown soils, which develop under a semiarid climate, constitute virtually all of this Zonal group. The Browns make up approximately 8 percent of the basin soils; most of these north of the Yellowstone River. Brown soils are moderately fertile with an accumulation of calcium carbonate and lesser amounts of magnesium carbonate in a three inch band at depths of 12 to 15 inches. The scant annual rainfall is insufficient to assure a crop. Dry farming, a technique of moisture conservation for crop production in semiarid climates, is the most common system of raising small grains. Grain is planted in the fall on fields kept clear of all vegetation during the spring and summer. The stored moisture from the past summer's rain, germinates

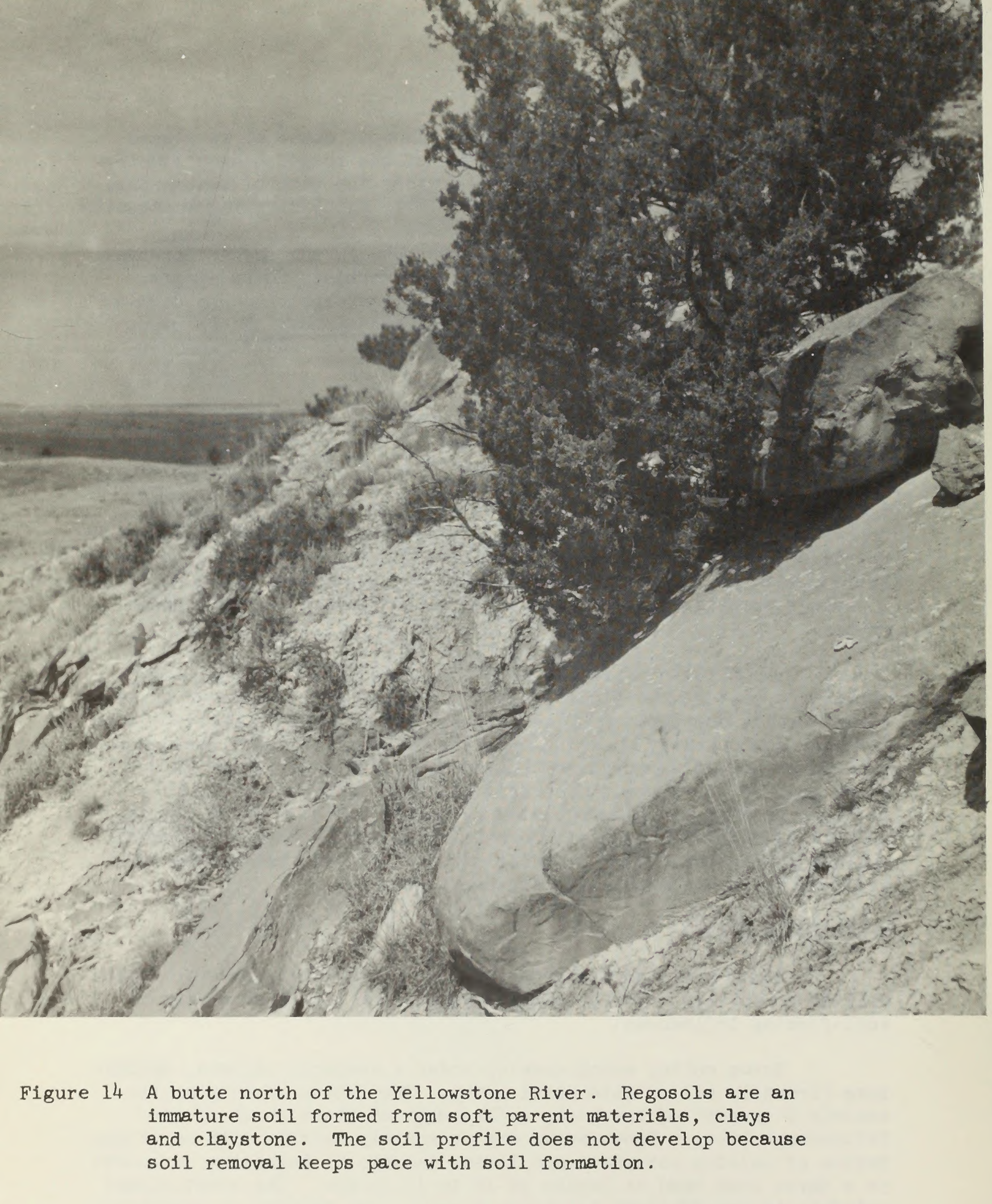


Figure 14 A butte north of the Yellowstone River. Regosols are an immature soil formed from soft parent materials, clays and claystone. The soil profile does not develop because soil removal keeps pace with soil formation.

the grain which remains viable over winter and matures the next summer. If winter wheat is killed by freezing, a catch crop of spring wheat is commonly planted. Wheat is the major crop, with yields around 15 bushels to the acre.

At higher elevations, with increased rainfall, Chestnut soils develop. The Chestnuts are similar to the Brown soils but are more fertile and deeper, with a carbonate accumulation at depths of 15 to 20 inches below the surface.

Intrazonal Soils Group - 11 percent

The last large order of soil groups is that of the Intrazonal soils. Vegetation and climate have definite influence on formation of the Intrazonal soil, but in this group they are overridden by a local factor, such as parent materials of a saline shale or bentonite.

Grumosols, covering 10 percent of the subbasin are examples of soils dominated in their development by parent material. Grumosols are very deep heavy clays comprised of 30 to 50 percent montmorillonitic clays. Montmorillonites are lattice-clays remarkable for tremendous expansion or contraction when changing from dry to moist conditions (as much as 700 percent in a laboratory). As a consequence, these soils crack deeply causing runoff to enter the soil through the cracks. Great soil stresses, developed by cracking and expanding through drying and wetting, result in a churning action throughout the entire soil profile producing surface accumulations of once deeply buried rocks. In subhumid climates these soils are productive but in the semiarid climate of the Middle Yellowstone, they support native range plants and have a lower productivity than other similar depth nonsaline soils.

Solonchak and Solonetz soils north of the Yellowstone River are alkaline soils of minor acreages making up about 1 percent of the subbasin. They support limited amounts of salt-tolerant vegetation which is primarily of value for grazing by sheep.

Scoria, a red slag, has indirectly affected soil formation. Scoria, or clinker, was once molten rock formed in prehistoric subterranean coal fires. Figure 15. The soft clays and sandstones, once lying above the slag beds, eroded away, uncovering the scoria. Hard, resistant to erosion, the scoria remained, capping the ridges and buttes of the southern third of the subbasin where it perpetuates a rugged topography. The resulting steep slopes have a marked influence on soil development. Lying under the scoria-capped buttes and ridges are prominent red and yellow bands of subsoil, their original grays altered by the heat of burning coal. The warm tones of the buttes and mesas add to the scenic beauty of the open country.

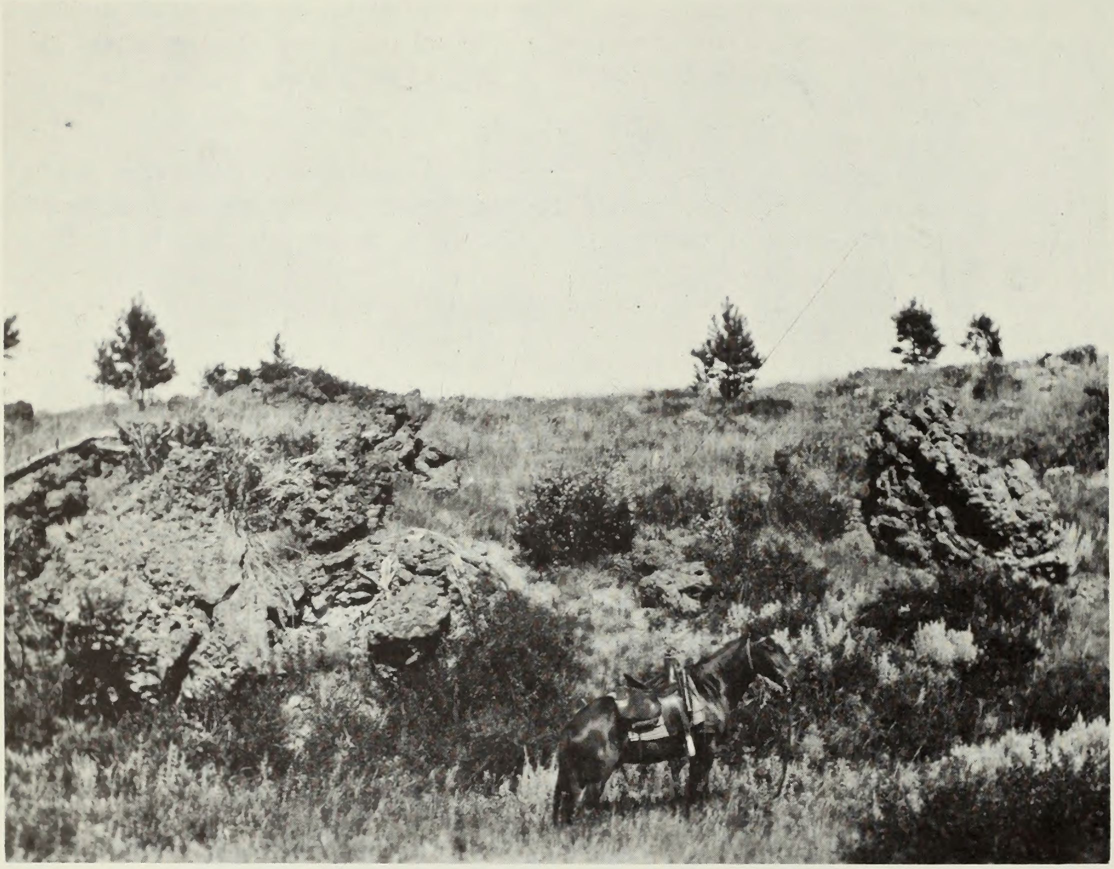


Figure 15 The two huge masses of rock shown are natural slag, hard, erosion-resistant and usually a bright shade of red. This natural slag (scoria) commonly lies in sheets or as gravel and small boulders rather than massively, as shown here. (U. S. Geological Survey Photo)

Soils of the Middle Yellowstone Area are generally well adapted to their present uses - livestock grazing, wildlife habitat, cultivation and watershed. The productivity varies, but over 80 percent of the soils are limited to permanent native vegetation. Throughout the Middle Yellowstone Area, especially on its saline alluvial soils, an unusual form of erosion called piping has developed and in some cases is responsible as the major agent for appearance of the landscape; this form of erosion is discussed in appendix B.

Vegetation [1]

Excluding cultivated lands of about 225,000 acres the Middle Yellowstone Area is rather evenly divided between grassland range, and stands of pine with an understory of grass. Figure 16.

Of the two million acres of grasslands, 422,000 acres have a scattered to fairly dense stand of conspicuous shrubs that make up less than 20 percent of total forage. Three shrubs are important: Gardner saltbush, 217,000 acres; big sagebrush, 132,000 acres; and black greasewood, 73,000 acres. The remaining grassland, of about one and one-half million acres, is a mixture with needlegrasses, wheatgrasses, and blue grama predominating.

Two million acres support ponderosa pine varying from light to medium stands of commercial timber, to dwarfed individual trees scattered along the low rocky ridges. The most common grass beneath the ponderosa pine is bearded bluebunch wheatgrass. The flood-plain forest of about 130,000 acres is mainly cottonwood, with roses and wheatgrass understory lying along the valley of the Yellowstone River.

Over 265,000 acres or 77 percent of the public lands, are grasslands; 1,100 acres, of less than 1 percent, have fairly dense ponderosa pine cover. Around 40,000 acres, or about 11 percent of the public lands, are grasslands on which big sagebrush is conspicuous; another 24,000 acres of grasslands, or about 7 percent of the public lands, have Gardner saltbush, and 1,400 acres of grassland, less than 1 percent support black greasewood.

Annual grasses, half-shrubs, wasteland, barren, broadleaf trees and reseeded rangeland total about 5 percent or 17,000 acres.

Range forage varies annually; weather affects the yield profoundly. Weather, management and potential productiveness of a range all determine the carrying capacity.

The grasses, mainstay of the range livestock industry, begin growth in late March or early April; most are cured by late July or early August. The taller perennial and some annual grasses may make new growth on fall rains.

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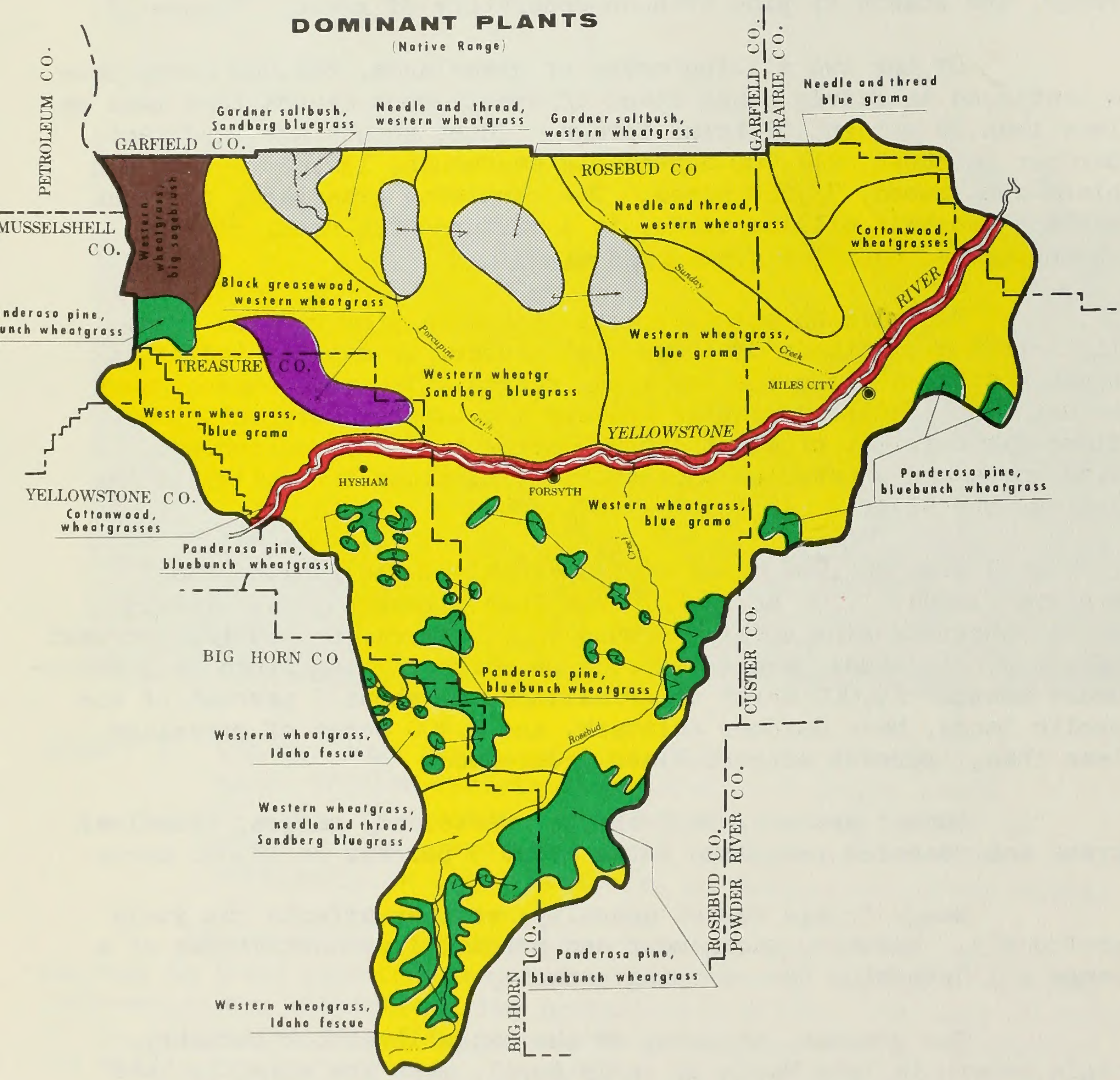
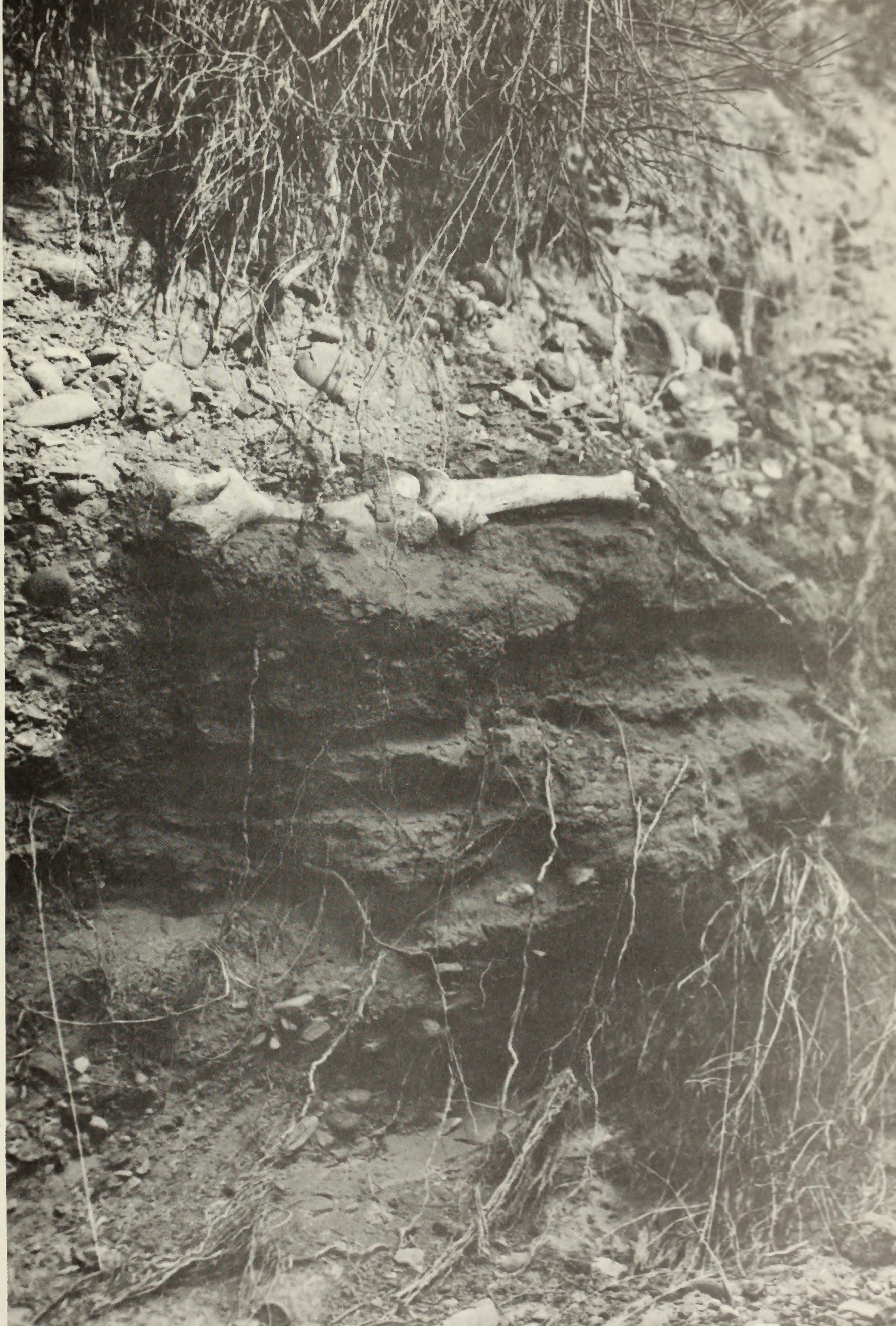
[1] A general map on vegetation, Sheet 90, U. S. National Atlas, U. S. Geological Survey, based on Küchler's work, "Potential Natural Vegetation of the Conterminous United States, 1964" is reproduced in appendix B for the Middle Yellowstone area.

gure 16


DOMINANT PLANTS
(Native Range)
PETROLEUM CO.
GARFIELD CO.
MUSSELSHELL CO.
GARFIELD CO.
PRAIRIE CO.
ROSEBUD CO
TREASURE CO.
YELLOWSTONE CO.
BIG HORN CO
CUSTER CO.
ROSEBUD CO.
POWDER RIVER CO.
BIG HORN CO.
Gardner saltbush, Sandberg bluegrass
Needle and thread, western wheatgrass
Gardner saltbush, western wheatgrass
Needle and thread blue grama
Western wheatgrass, big sagebrush
Needle and thread, western wheatgrass
Cottonwood, wheatgrasses
nderosa pine, unch wheatgrass
Black greasewood, western wheatgrass
Western wheatgrass, blue grama
Western wheatgr Sandberg bluegrass
Western whea grass, blue grama
Ponderosa pine, bluebunch wheatgrass
YELLOWSTONE RIVER
Sunday
Creek
Porcupine
Creek
MILES CITY
HYSHAM
FORSYTH
Cottonwood, wheatgrasses
Ponderosa pine, bluebunch wheatgrass
Western wheatgrass, blue grama
Creek
Ponderosa pine, bluebunch wheatgrass
Western wheatgrass, Idaho fescue
Rosebud
Western wheatgrass, needle and thread, Sandberg bluegrass
Ponderosa pine, bluebunch wheatgrass
Western wheatgrass, Idaho fescue



EARLY EXPLORERS-
MIDDLE YELLOWSTONE RIVER AREA

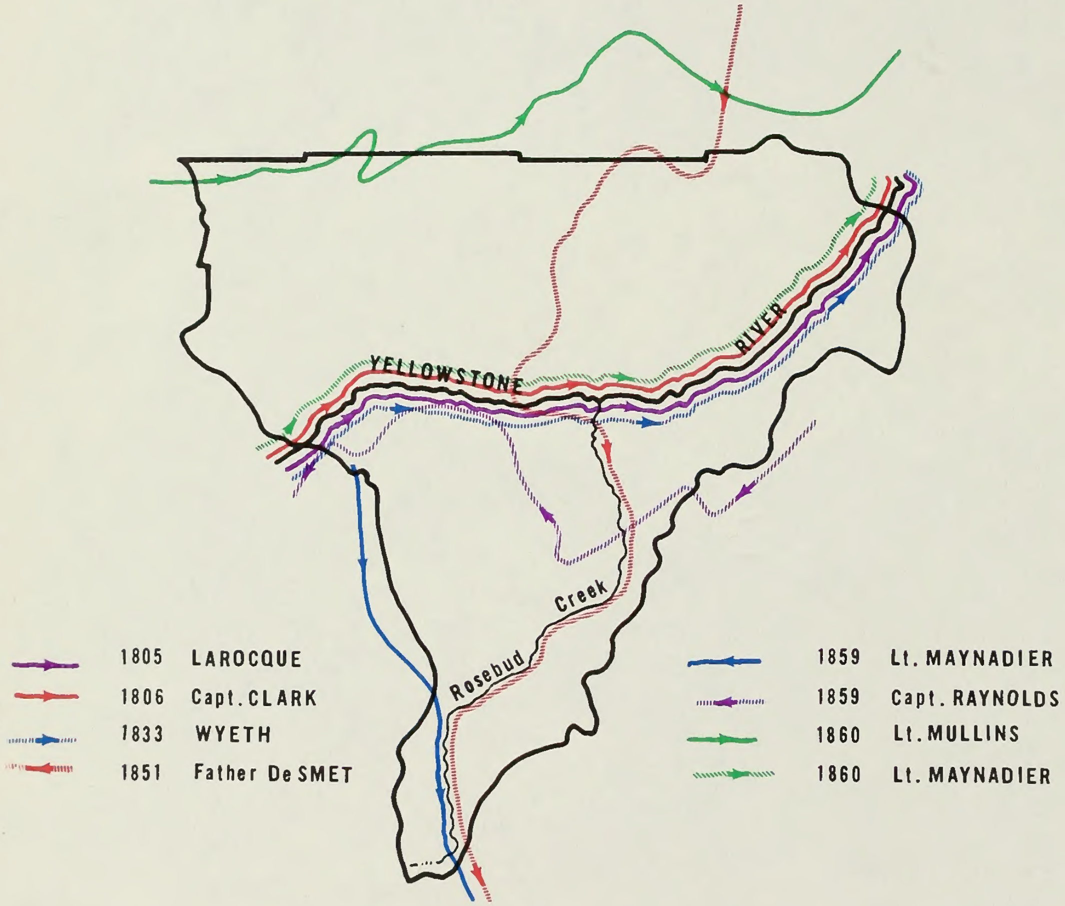


Figure 17

In A.D. 1200 related stocks (Navaho and Apache) from the Red River of the North had migrated south on foot across the plains. They left few settlers on the great expanses of northern grasslands. Opportunities for growing crops were limited because of the light rainfall. Hunting was difficult because game migrated freely and moved with speed and ease over the long distances. Thus, the Northern Great Plains stood almost empty except along its fringes. Not until the Indians acquired the horse from the Spanish were the plains to become an avenue of easy travel and a reliable source of food.

Firearms acquired from Canadians and American fur traders in the northeast forced the occupation of the plains. Eastern tribes were displaced by Canadian and American white settlers moving westward. The eastern Indians armed with muskets and rifles, shifting to the west and south, forced other tribes ahead of them onto the grasslands.

British fur companies, after the Louisiana Purchase, grew alarmed at the prospects of the immediate exploration of the territory by Lewis and Clark. The Northwest Company sent three employees to intercept the Americans and join them if possible. The meeting was at the winter quarters of Lewis and Clark, but nothing came of it. One of the Northwest Company's men, Antoine Larocque, went on the following spring (1805) into the Yellowstone country to establish trading relationships with the Indians before Lewis and Clark.

Larocque traveled with the Crow Indians for months. Thus it was that Larocque reaching as far west as the present site of Billings, preceded Clark through the lower Yellowstone valley.

In 1806, on their return trip, Lewis and Clark separated when they reached the present western boundary of Montana. William Clark led a mounted party eastward over a new route to the Yellowstone River. East of the Three Forks of the Missouri River, he crossed the divide of the Yellowstone River. At the first suitable timber, not far upstream from the present site of Laurel, Montana, Clark built canoes. Here, half of his horses were stolen, so it was necessary for most of the party to continue downstream by canoe. The few horses left were herded cross-country by Sgt. Pryor and two men. Two days later these horses were also stolen. The three men returned to the river and constructed a bull-boat to follow Clark downstream.

In 1833, Nathaniel Wyeth, fur trader and trapper, led a small party of trappers on foot through the Big Horn Basin; there, building a hide bull-boat they floated through the canyon of the Big Horn River to the Yellowstone and down to the Missouri.

In 1851 Father De Smet traveled through the Yellowstone River Area from north to south.

In 1859-1860 U. S. Army Officers under direction of topographical engineer Captain Raynolds crossed and re-entered the subbasin. Captain Raynolds was exploring the Yellowstone River Basin.

Because of the value of these reports from reliable and objective observers, pertinent remarks from their journals, on soils, erosion, water quality, wildlife, timber, and vegetation are quoted in appendix B.

The early explorers were followed by traders and trappers, and several forts were built along the Yellowstone River. At the mouth of the Big Horn River, several forts were to be constructed through the years. The first, Fort Lisa, was built in 1807.

In 1835, Fort Van Buren was built near the Tongue River; it was burned in 1842 by Charles Larpenteur when he built Fort Alexander opposite the mouth of Armell's Creek. That fort was abandoned in 1850 when Fort Sarpy was built a few miles upstream. Abandoned in turn in 1859, Fort Sarpy was the last trading post in the Middle Yellowstone. Captain Raynolds described it:

> "We found the trading house situated in the timber on what during high water would be an island, a channel, now dry, passed to the south of it. The "fort" is an enclosure about 100 feet square, of upright cottonwood logs about 15 feet high, the outer wall also forming the exterior of a row of log-cabins which were occupied as dwelling houses, store houses, shops, and stables. The roof of these structures are nearly flat, and formed of timber covered to a debth of about a foot with dirt, thus making an excellent parapet for the purpose of defense. The preparations for resistance to possible attacks being further perfected by loopholes in the upper part of the outer row of logs. The entrance is through a heavy gate which is always carefully closed at night. No flanking arrangements whatever exist, and the "fort" is thus a decidedly primitive affair."

The Farmers and the Settlers

After the traders and trappers came the farmers and settlers. Before the basin could be settled, three situations hindering the white men had to be changed: first, raids by Sioux Indians from the Dakota reservations had to be controlled; second, the buffalo had to be cleared from the range; and third, transportation to eastern markets had to be developed.

The first of these problems, the Indian raids, became an objective of the military. By 1876 the Army was in the field in force. On June 17 at the Battle of the Rosebud, on the upper reaches of Rosebud Creek, General Crook with more than 1,000 soldiers and 300 Crow and Shoshone Indian Scouts met Crazy Horse with 1,500 Sioux and Cheyenne warriors. Following an engagement of about four hours the forces withdrew; Crook's losses were 11 killed and 31 wounded, the Indian losses were 36 dead and 63 wounded. That same month, Lieutenant Colonel Custer scouted up the Rosebud and then, paying no heed to his orders, rode to his death - and the deaths of 250 of the 7th Cavalry in the Battle of the Little Big Horn.

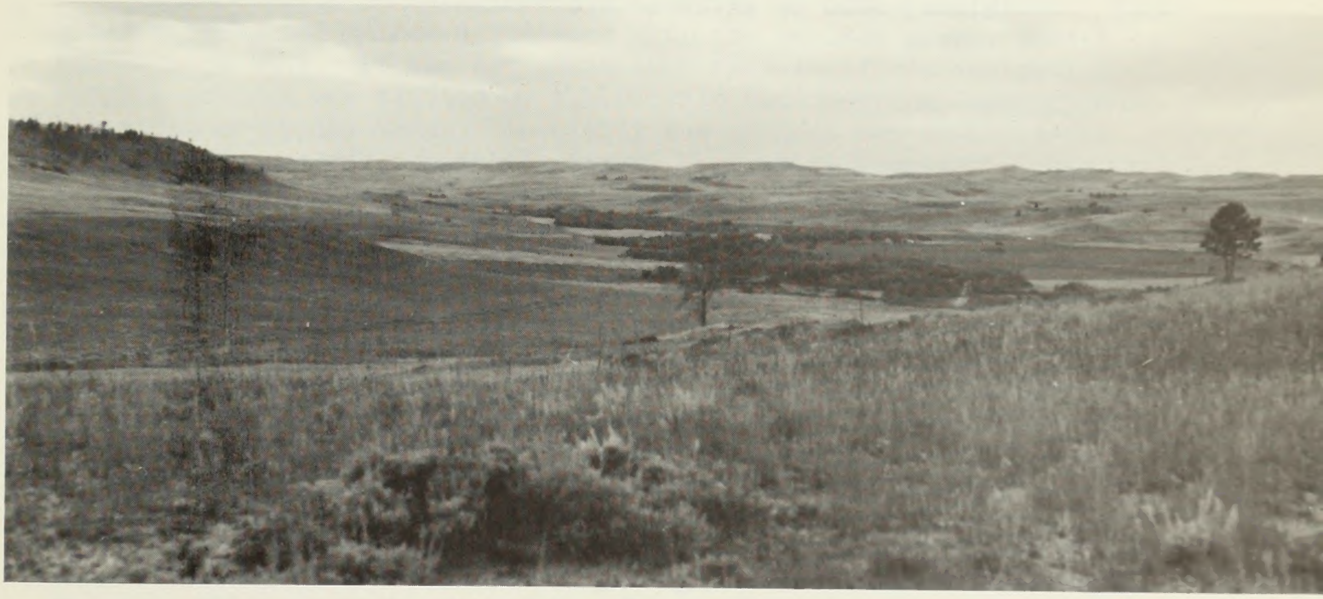


Figure 18 Site of the Battle of the Rosebud, June 17, 1876, at the head of Rosebud Creek.

The ensuing winter campaign led by Colonel Nelson Miles drove the Indians from their winter camps by 1877. Fighting stopped completely in 1881 with the surrender of Sitting Bull.

During the Indian Wars, the Tongue River Cantonment was built near the mouth of the Tongue River. Milestown, the earliest settlement in the Middle Yellowstone subbasin, was established when Colonel Miles ordered all civilians out of the Cantonment. In 1878 Fort Keogh was built about three miles upstream on the Yellowstone River. At the same time Milestown changed its name to Miles City and moved to its present location.

The 1½ million buffalo of the northern herd were in competition with livestock for the forage, so in order to graze cattle and sheep and to plant crops, the buffalo were eliminated. By 1879 hide hunters were working out of Miles City. Excerpts from the Yellowstone Journal, the newspaper at Miles City, show the results:

January 17, 1880

> "Jas. White, the boss buffalo hunter came to town Thursday to dispose of his hides, 2000 of which he secured this season.

October 15, 1881

> "Twelve hundred tons of hides were shipped from Montana this year by H. C. Tilhaghast & co., of Chicago.

March 3, 1883

> "G. W. Baldwin, the hide buyer shipped two carloads of buffalo hides to Chicago Thursday. That Baldwin can catch on where another would get left, is shown by his ceaseless shipping of hides, while other buyers complain of the dullness of the season."

The "dullness of the season" marked the solution to the second problem for would-be settlers as it signaled the end of the buffalo herd.

The third problem was the lack of adequate transportation for settlement of the country. Although river boats had a regular service on the Yellowstone as far upstream as Coulson, (Billings, Montana) they were unreliable. Adequate transportation awaited the coming of the railroad. The Northern Pacific Railway reached Bismark, North Dakota by 1873; financial difficulties slowed construction but in 1881 the tracks reached Miles City.

With the Indians on the reservation, the buffalo gone, and the railroad at Miles City, the range was opened to large scale ranching. The earliest settlers were cattle ranchers with the nucleus of their livestock coming from the southern trail herds. With the buffalo eliminated, the Indians confined to reservations starved. The Federal government bought local beef to feed them thereby creating a new cattle market close at hand. Cattle numbers boomed, the luxurious grass from unusually favorable years attracted even more trail herds. In 1884 a drought hit. In 1885 President Cleveland ordered all trespass cattle off the Indian reservations forcing a quarter of a million head of cattle onto short range. The drought continued through 1886. The winter was a disaster. The snow came early in November, the temperatures fluctuated violently all winter, snow covered the forage until March. Cattle losses were between 30 and 60 percent. By the spring of 1887, the cattle industry was almost wiped out. It revived with establishment of farms and a source of winter feed.

Farming started slowly in the basin with small private irrigation projects. It expanded when livestock operations replaced yearlong dependence on range with winter feeding of harvested crops. Irrigated farming had gained a foothold with the passage of the Desert Land Act of 1877. It was not until 1896 that the first irrigation company project was started by the Buffalo Rapids Ditch Company near the mouth of Sunday Creek. Initially the project was unsuccessful until it was reorganized as the Kinsey Irrigation Company. Other irrigation projects were; Rancher Ditch Company 1903; Yellowstone Irrigation Ditch (started as the Sanders-Howard Cooperative Ditch Company) 1906; Sheffield Ranch Company 1919; and the Hysham Pumping Project 1945.

Dryland farming followed irrigation farming into the area and increased until the drouth of 1917. Recently it has declined in importance. Many submarginal farms, mostly dryland, were purchased by the Federal government under provisions of the Bankhead-Jones Act of 1937, following the drouths of the 1930's. This created a new class of federal ownership known as the LU (Land Utilization) lands.

A significant contribution to industrial development in the Middle Yellowstone resulted from opening of coal beds at the town of Colstrip in Rosebud County. Coal was strip-mined for many years, to supply the railroad. More recently the Colstrip fields were designated as the fuel source for thermo-electric power generation at Billings.

The Middle Yellowstone Area will remain essentially as it is for a long period. Livestock ranches and farms, irrigated and dryland crops plus a slowly growing industrial economy lie in the future. This area will probably remain most closely identified with extensive use of the rangeland and timber by wildlife and livestock.

ECONOMIC AND SOCIAL DEVELOPMENT

General

Trades and services centering around Miles City account for about a $48 million annual income. Agriculture, with $18 million annual income ranks second. Minerals, tourism, forest products, and manufacturing support noticeable but less important segments of the economy.

In 1962, the median family income of $4,700 in the Middle Yellowstone subbasin was slightly below the Statewide average.

From the time of early settlement, population increased fairly rapidly until 1920, when a leveling took place. Populations are fairly well stabilized, with approximately 21,000 persons residing in the subbasin, nearly 10,000 of them in Miles City.

In common with the rest of the United States, farms and ranches in Montana have been diminishing in number since 1920. In the Middle Yellowstone subbasin they decreased at an average rate of 21 per year between 1954 and 1964; at the same time, average size increased about 145 acres per year. Across the State of Montana, farms and ranches decreased in number from 33,060 to 27,020, while average size increased from 1,860 acres to 2,440 acres.

The income from the farm has not kept up with the necessary capital investment in land and buildings. The capital investment in Montana farms and ranches by 1959 was over $2 billion, giving a net return on the investment of less than 1 percent, whereas in 1950 the investment was less than $1 billion and the net return was 2.38 percent.

Farm families are moving into small towns and commuting to the farm, as illustrated in population figures for Montana in one decade:

1950	1960
258,034 Urban 44%	338,457 Urban 50%
332,990 Rural 56%	336,310 Rural 50%

Population of the predominantly agricultural counties is dropping, only Custer County because of its urban environment and industrialization gained.

	1950	1960
Rosebud County	6,570	6,187
Treasure County	1,402	1,345
Custer County	12,661	13,227

Agriculture

Agricultural enterprises include ranches, dry land farms and irrigated farms. Most of the agricultural income (75 to 80 percent) in the Middle Yellowstone Basin is from livestock and livestock products. Sheep, lamb, and wool production are important but show a steady decline whereas cattle production is increasingly important. Figure 19. By 1963 cattle made up 55% (150,600) of the total livestock. Sheep and lambs made up 31% (83,400) of the livestock. Sheep enterprise has declined because of the scarcity and high price of skilled labor.

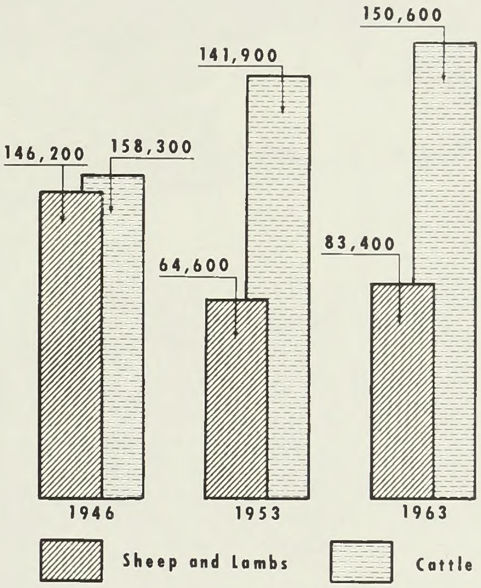


Figure 19 Changes in relative numbers of livestock in the Middle Yellowstone Area.

The acreage of cropland in dry land or irrigation varies yearly with weather cycles and the demand for products. Figure 20. In the subbasin about 59,000 acres are regularly irrigated although 81,000 acres are irrigable with existing systems. Approximately 106,000 acres are dry farmed. Figure 21. About 20 to 25 percent of the annual farm income is from crops. The annual average net income per acre is about $85 for irrigated cropland compared to $30 for non-irrigated cropland.

The most important crops by acreage are hay, wheat, barley and sugar beets. Grain, principally wheat, is planted on non-irrigated cropland. Sugar beets and hay are harvested from the irrigated cropland.

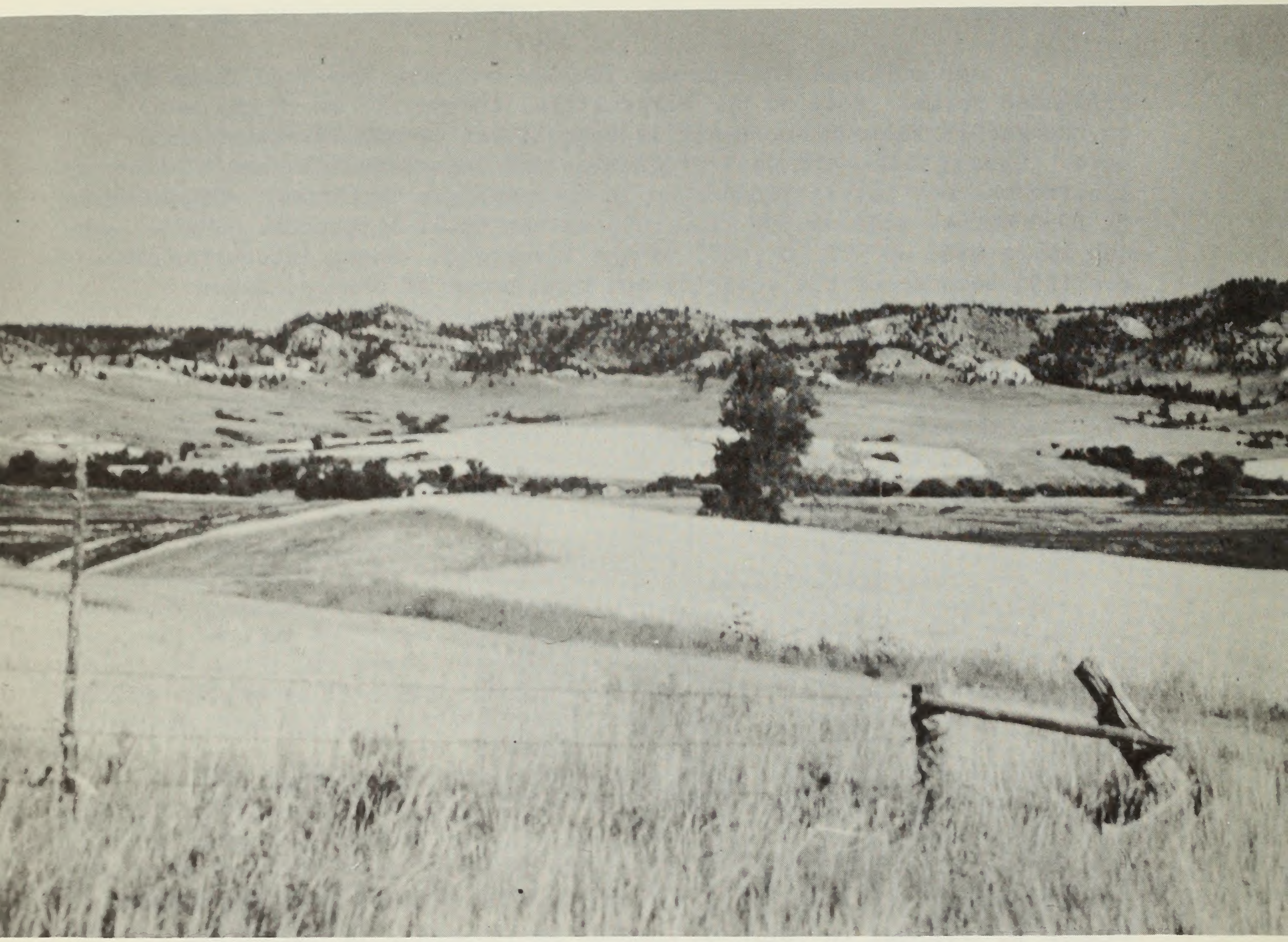


Figure 20 Upper Rosebud Creek south of Busby, Montana. The alluvial soils of the valley support irrigated hay next to the creek and dryland crops in the foreground. The creek is perennial but provides only a limited source of irrigation water.

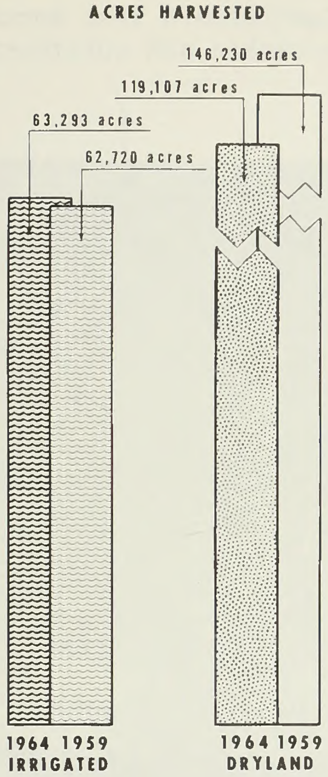


Figure 21

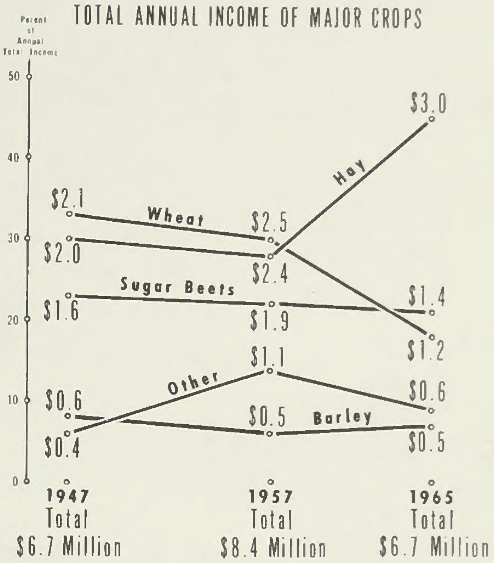


Figure 22

Hay is the leading crop. In 1965 its value was almost $3 million from 99,000 acres. Figure 22. Hay is primarily alfalfa from irrigated land, but a part of it is from native grass meadows. The increased production of cattle results in the increased production of hay which is needed for winter feed. Wheat is the next crop, followed by sugar beets and barley. Market quotas are responsible for the decrease in sugar beet production.

Forestry

Lumbering contributes a small part to the economy of the subbasin. Two sawmills at Lame Deer, Montana are each capable of processing one million board feet annually. Figure 23. About half the logs processed there come from the Northern Cheyenne Indian Reservation. The other major source of logs is the Custer National Forest in the adjoining Tongue River subbasin.

The present annual timber harvests are conservative. On the Northern Cheyenne Indian Reservation, for example, the cut is roughly one million board feet annually. A new policy aimed at harvesting over-mature and mature trees could increase the annual cut by several times. Concurrently the National Forest cut might be raised substantially. This combination plus timber from private land and public domain could produce a maximum of about 11,000,000 board feet annually. A modern large-sized sawmill contributing to a stable and substantial economy could thus be supported.

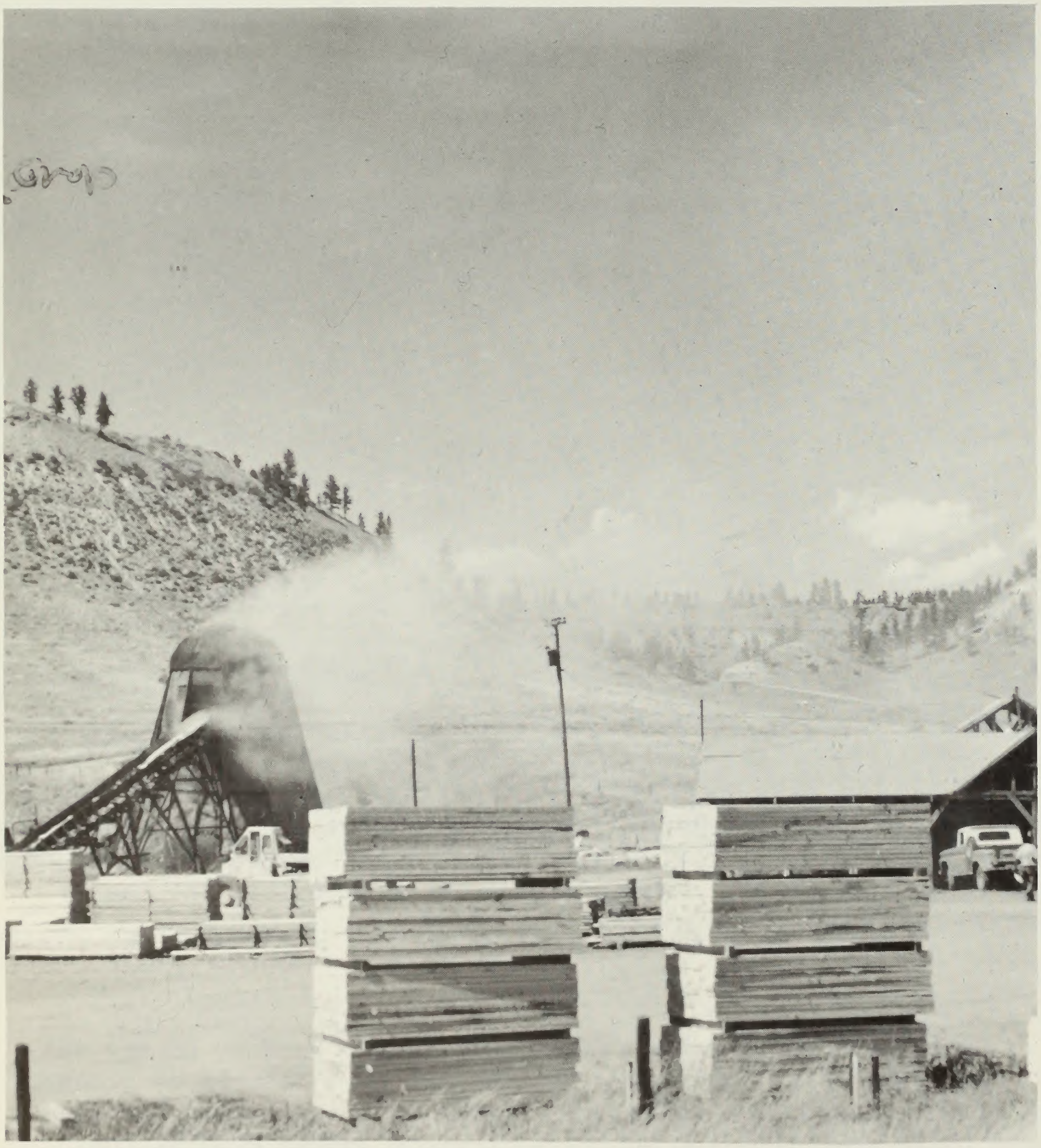


Figure 23 This sawmill at Lame Deer, Montana, with an annual capacity of one million board feet, processes ponderosa pine from the Northern Cheyenne Indian Reservation and nearby Custer National Forest.

Most of the trees outside of the rugged high plateaus are ponderosa pine with only limited amounts of saw timber. Figure 24. The public domain produces little saw timber, but it does produce poles, posts, firewood, and similar miscellaneous forest products.

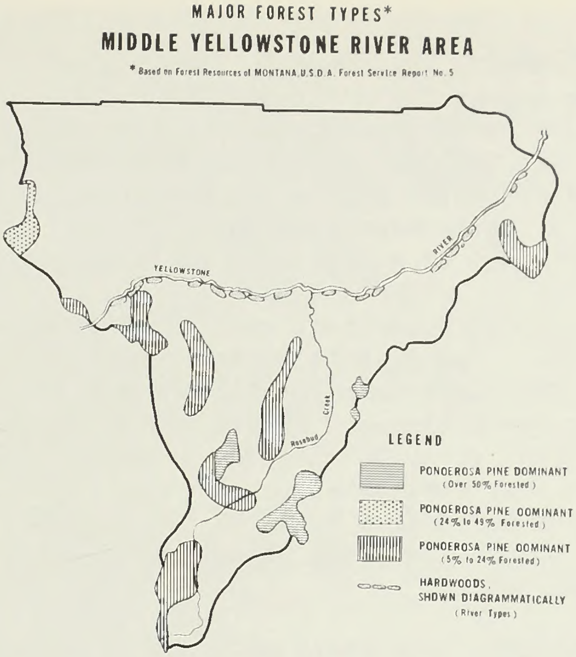

MAJOR FOREST TYPES*
MIDDLE YELLOWSTONE RIVER AREA
* Based on Forest Resources of MONTANA, U.S.D.A. Forest Service Report No. 5
YELLOWSTONE
RIVER
Rosebud
Creek
LEGEND
PONDEROSA PINE DOMINANT (Over 50% Forested)
PONDEROSA PINE DOMINANT (24% to 49% Forested)
PONDEROSA PINE DOMINANT (5% to 24% Forested)
HARDWOODS, SHOWN DIAGRAMMATICALLY (River Types)

Figure 24

The forests have important values from the standpoint of watershed protection, esthetics, and cover for wildlife.

Mining and Minerals

The mineral resources of the Middle Yellowstone River Area include oil, gas, coal, bentonite, sand, gravel and stone. There are no known metallic mineral resources.

Statistical information is available only for oil and gas produced from a field in the northwest corner of the area. In 1960, 3,776,000 barrels of oil having a value of $8,529,000 were recovered. Since that time, production has declined steadily to 1,004,000 barrels in 1967, with a value of $2,474,000. Gas production, also, is declining; in 1967, a total of 493,905,000 cubic feet was produced with a value of $25,000; production in 1966 amounted to 603,030,000 cubic feet.

Much, if not most, of the area has not been explored; even where it has been tested, many drill holes penetrated only a part of the possible oil-and-gas bearing horizons. Geologic formations, which are oil-bearing elsewhere, are present. Additional subsurface exploration will bring these to light.

Captain Clark first reported, July 28, 1806, on the vast beds of coal underlying eastern Montana.

> "...in the evening I pass^{d}. Straters of
> Coal in the banks on either Side those on

> the Star^{d}. Bluffs was about 30 feet above the water and in 2 vanes from 4 to 8 feet thick, in a horozontal position. the coal contained in the Lar^{d}. Bluffs is in Several vaines of different hights and thickness. the coal or carbonated wood is like that of the Missouri of an inferior quallity..."

On the 29th he noted "... great quantities of coal in all the hills I passed this day..." and just below the Tongue River he wrote "...at a few miles from The Rochejohne the hills are high and rugged containing coal in great quantities..." Clark could not have dreamed of the magnitude of the coal reserves although he twice repeated "great quantities". The vast coal reserves (down to 2,000 feet) of Custer, Treasure and Rosebud counties total 42,856.3 millions of tons of subbituminous coal. The shallow beds of strippable coal are estimated at $2\frac{1}{2}$ billion tons.

The easily available coal meant millions of dollars in the past for development of the railroads and will mean even greater contributions to the economy of the future.

The transition from coal to oil and gas as a source of energy, particularly by the railroads, almost put an end to the coal industry in Montana. In 1944 Montana produced almost 5 million tons of coal but in 1967 the total Montana production had fallen to 371,000 tons - an all-time low.

During the heyday of Montana coal mining, about one-half of the coal came from the Colstrip pit, located 30 miles south of Forsyth. The pit operated from 1923 to 1957, the coal being sold to the Northern Pacific Railway. The pit was closed until 1968, when it was reopened to supply coal to thermo-electric generating plants in Billings, Montana, and Cohasset, Minnesota. Initial production will be about $2\frac{1}{2}$ million tons per year, increasing gradually to 3 million tons or more by 1980. Figure 25. The Montana Power Company has an estimated 850 million tons of coal-reserve land leased. In the next 30 years 375 million tons of coal will be needed to meet the requirements for thermo-electric plants.

There is every indication that Montana's coal industry is verging on a significant upswing. At the present time, there are 25,000 acres under Federal lease and permit or application for lease and permit, and 1,500 acres under lease from the State of Montana in the Middle Yellowstone Area. These lands contain many hundreds of millions of tons of coal, with far more land still to be leased.

Almost $2\frac{1}{2}$ billion tons of strippable subbituminous coal reserves are estimated to underlay the Middle Yellowstone River Area. Figure 26. The coal is well-suited for burning in steam-electric generating plants and for the manufacture of liquid hydrocarbons,

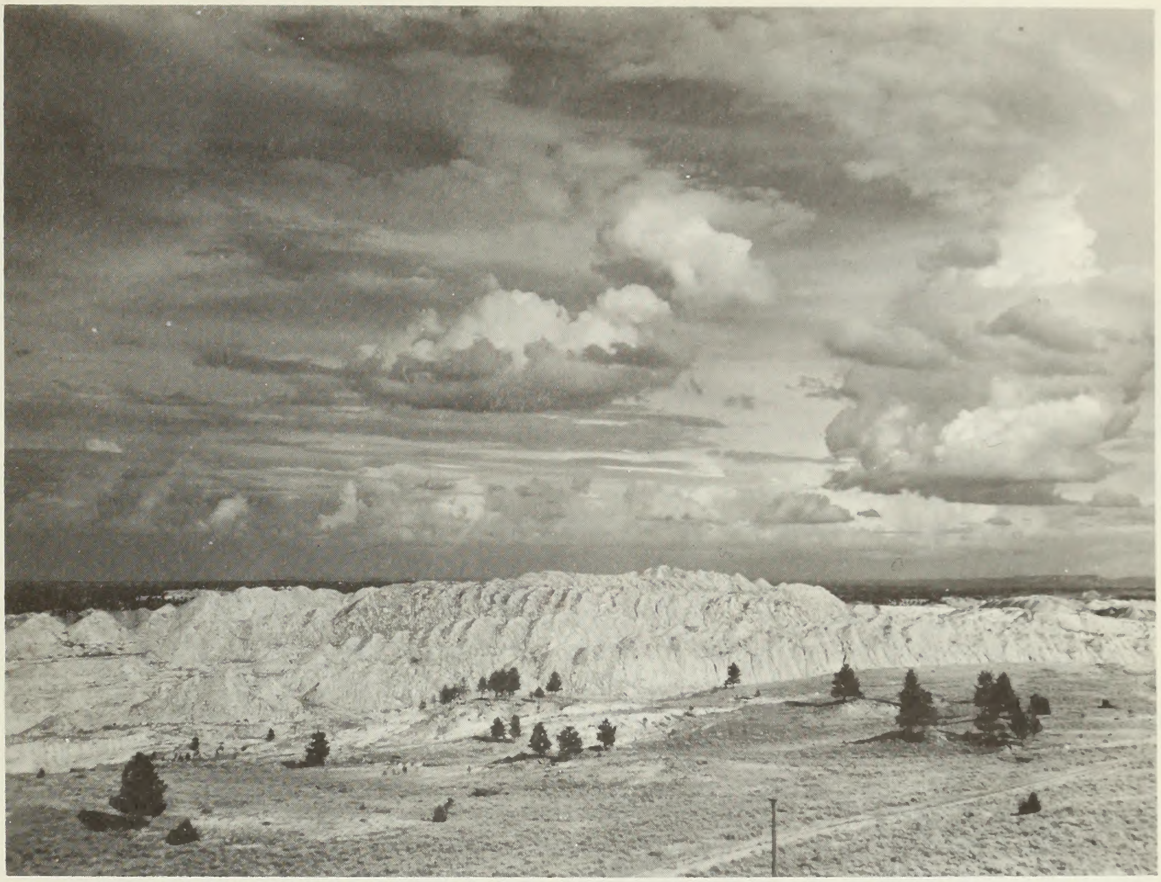
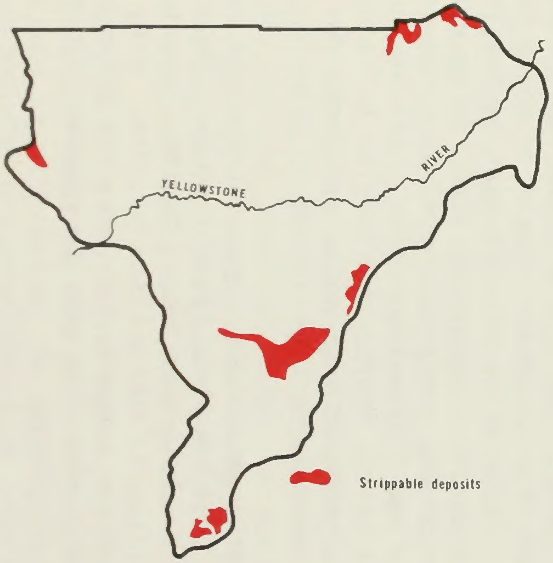


Figure 25 Spoil from strip-mining coal. The open-pit mines at Colstrip are a major source of fossil fuel in eastern Montana and produce fuel for thermo-electric power plants at Billings, Montana.

pipeline gas and other products. The Tongue River flows northward immediately to the east and is a potential source of water needed by future processing plants. Fifty miles further east is the Powder River now under consideration for a reservoir site; fifty miles north from the geographic center of the strippable coal reserves in the Middle Yellowstone area is the Yellowstone River. All or part of six areas have been identified in the Middle Yellowstone in which coal and water are available, capable of supporting synthetic fuel plants producing 10,000 barrels per day for a period of 40 years.

A single integrated processing plant, whether it is located within the area or nearby will have significant social and economic impact on this and adjacent coal-rich areas. Capital investment will be of the order of 300 million to 400 million dollars. Many workers will be required to operate the plant and to mine and transport the necessary coal; a great many more jobs will be required to supply goods and services for these people.

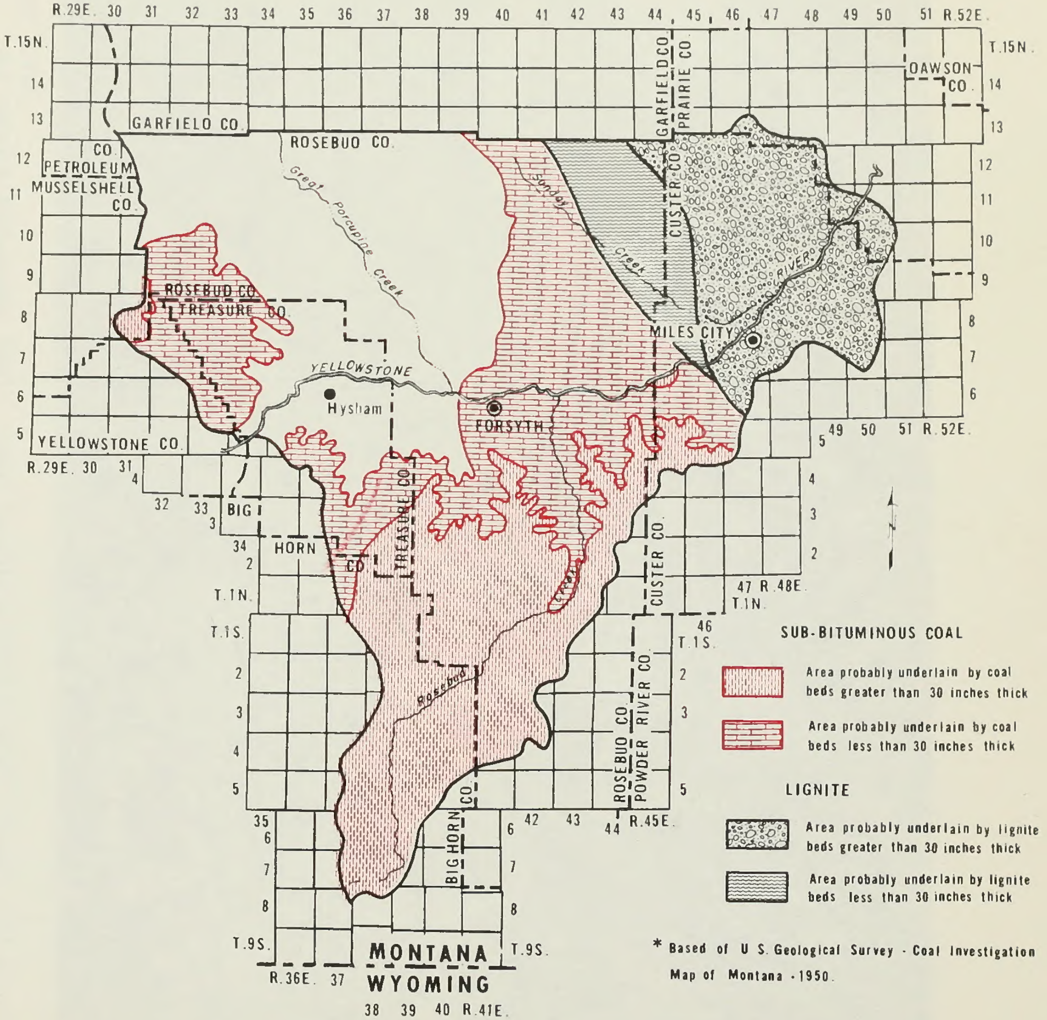
AREAS OF STRIPPABLE DEPOSITS **



** "Montana's Coal Resource Situation. A Summary Report to the 1969 Legislature."

Figure 26

COAL RESOURCES*


R.29E. 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 R.52E.
T.15N.
14
13
12
11
10
9
8
7
6
5
GARFIELD CO.
PETROLEUM CO.
MUSSELSHELL CO.
ROSEBUD CO.
TREASURE CO.
YELLOWSTONE CO.
BIG HORN CO.
CUSTER CO.
GARFIELD CO.
PRAIRIE CO.
DAWSON CO.
POWDER RIVER CO.
Great Porcupine Creek
Sunday Creek
YELLOWSTONE
RIVER
Rosebud
Hysham
FORSYTH
MILES CITY
47 R.48E.
T.1N.
T.1S.
R.45E.
T.9S.
R.36E. 37 38 39 40 R.41E.
MONTANA
WYOMING
SUB-BITUMINOUS COAL
Area probably underlain by coal beds greater than 30 inches thick
Area probably underlain by coal beds less than 30 inches thick
LIGNITE
Area probably underlain by lignite beds greater than 30 inches thick
Area probably underlain by lignite beds less than 30 inches thick

* Based of U. S. Geological Survey - Coal Investigation Map of Montana - 1950.

With no more than these few facts and predictions of probable things to come, it is not difficult to visualize many changes. Many will be beneficial but some will not, such as the surface damage from strip-mining practices and air and water pollution. However, these are controllable within acceptable limits.

Extensive bentonite deposits are mined north and west of Vananda. Twelve men operate the strip mines. Production runs from 20 to 30 railroad cars per week. The bentonite is shipped to Duluth, Minnesota, where it is used as binder in pelletizing taconite (iron) ore concentrate.

Deposits of sand and gravel lie along the Yellowstone River and its larger tributaries. They are mined by many private individuals for local building. Larger quantities are used by the State and County Highway Departments for road and highway construction and maintenance. The supply is adequate for a long time to come.

Ground water is found chiefly in the sandstone beds of the Fox Hills, Hill Creek and Fort Union formations in the alluvium in the flood plains of the major streams, and in the terrace gravels along the Yellowstone River. A number of flowing artesian water wells are reported along the Yellowstone River valley east of Forsyth.

In general, the deeper drilled wells provide a better quality of water than shallower wells. All of the drilled well water is hard; some is not suitable for even livestock or irrigation purposes. Water from the terrace gravels is suitable for domestic and irrigation uses. Water in the alluvium is quite variable in quality, or hardness, and in quantity. It is, however, widely used for domestic, irrigation, livestock and for minor industrial needs.

Transportation and Communications

The Yellowstone River Valley is a natural east-west travel route. Agricultural development in Montana progressed from west to east, however, because of early initiation of irrigation in the western section. For a short time, in 1874, the head of steamboat navigation lay in the Middle Yellowstone subbasin on the Yellowstone River, until supplanted by Junction City and later by Coulson (Billings). The first railhead was established in 1881 at Miles City.

The earliest mining camps of western Montana depended on supplies freighted overland from Fort Benton on the Missouri. Later the Yellowstone River was used for transportation. Travel from the mines went east, overland across Bozeman Pass to the Big Bend of the Yellowstone, near present day Livingston. There Mackinaw boats were constructed to float people and goods downstream to join Missouri River steamboats and thence to St. Louis. They traveled in groups, with surprising speed; one large party made the 2,700 mile trip to

St. Louis in 28 days.

Among the more notable events in the development of transportation and communications in the Middle Yellowstone Area were the following:

1807 - Fort Manuel, Montana's first fur trading post was built on the western edge of the Middle Yellowstone Area at the mouth of the Big Horn River.

1851 - Alexander Culbertson and Father Pierre De Smet brought the first wagon train into the Yellowstone River valley.

1859 - Captain W. F. Raynolds, U. S. Army, continued the mapping and exploration of the Yellowstone valley begun by Captain Warren; his mission was to determine feasibility of rail and steamboat routes into the area. He rejected steamboats as being only temporary and impractical.

1863 - The first steamboat sailed up the Yellowstone River in support of an Army expedition led by General Alfred Sulley.

1864 - Gold miners brought the first Mackinaw boats down the Yellowstone River from its big bend near Livingston.

1872 - The Fort Ellis, Bozeman, Fort Keogh Road was established; the daily schedule covered 325 miles with a fare of $42 per passenger. The same year the Bismarck-Fort Keogh mail route began, first with weekly and then with daily runs; again, the fare was $42 per passenger.

Miles City-Deadwood Mail and stagecoach route started weekly runs.

Communication from Miles City east to Fort Lincoln depended on the rapid and effective heliograph which worked when the sun shone.

Ranching began in a small way in the Yellowstone subbasin.

1877 - Miles City became the center of commercial buffalo hunting; the market price was $3.50 per hide.

Telegraph service was inaugurated into Miles City from both Deadwood and Bismarck.

Junction City at the confluence of the Yellowstone and Big Horn Rivers was established as the navigational head of the Yellowstone River.

1879 - The first telephone line linked Fort Keogh in Montana to Fort Lincoln in North Dakota.

1880 - The first herd of Texas Longhorns was driven into the Yellowstone subbasin over the northern trail via Cheyenne.

1881 - The Northern Pacific Railway reached Miles City, population 1,000.

1910 - The era of open-range came to a close in the Yellowstone subbasin.

When the Northern Pacific Railway reached Miles City in 1881, transportation by river boat dwindled. By 1883, the Northern Pacific had laid track the length of the Yellowstone valley. The Chicago-Milwaukee-St. Paul and Pacific Railroad came later. The thirty-five mile Colstrip spur connects the vast Rosebud coal fields with the main Northern Pacific line.

Each mile of railroad track serves 25 square miles in the Middle Yellowstone Area as compared with 30 square miles for the State of Montana and 14 square miles for the contiguous 48 states.

Interstate 94 is a major route for east-west travel, traversing the subbasin for a distance of 125 miles. Surveys by the Montana State Highway Commission indicate that about 25 percent of all interstate traffic in Montana uses Interstate 94. About 83 percent of the incoming traffic is tourist travel. U. S. Highway 212 traverses the southern part of the subbasin from east to west. This route gives access to the Northern Cheyenne Indian Reservation, the Custer National Monument to the west, and the Black Hills and Badlands of South Dakota to the east.

Paved roads make up 79 percent of the total subbasin road mileage. This gives a ratio of about 17 square miles of land per mile of road in the subbasin, which is better than Montana's average of 20 square miles per mile of road. The United States average is 0.9 square miles of area per mile of road.

Buslines and airlines connect through Billings with National and International routes to Denver, Colorado, and to points in Canada An oil pipeline connects the refineries at Billings, Montana with

Glendive, Montana and the fields to the east; another line from the Sumatra oil field runs southwest to Billings.

Commerce, Trade and Economic Conditions

Within the subbasin, sales and service enterprises produce the most income. The most recent figures list 260 retail establishments with sales of $26 million.

Thirty-five wholesale firms reported $18 million in sales, and 120 service enterprises had an income of $2.3 million.

Fifteen manufacturing industries employed 160 people to add about $1.3 million to the economy.

The number of enterprises has remained relatively stable, with an increase in dollar volume of business due to inflation and higher prices.

One and two-teacher elementary schools based in semi-mobile trailers are typical in the rural areas of the subbasin. Most of the rural high school students come to school by bus or move to town to finish their work at a higher level. Miles City has a two-year Junior College.

Retail and wholesale stores and services are concentrated in the county seat towns.

The subbasin is supplied with electricity by a network of private and public power lines. Miles City is connected by a 115 kv transmission line with the hydro-electric power plant at Fort Peck Reservoir. This source of power is augmented by a private thermal plant at Miles City having a peak output of 2600 kilowatts.

Forsyth, Rosebud and Miles City are connected by private power line with major cities downriver. Forsyth and Hysham are supplied with power by a publicly owned line that runs upriver. In addition to the major transmission lines, cooperatives supply electric power to the rural areas of the subbasin.

A 12-inch, privately-owned gas pipeline supplies Forsyth and cities further down the Yellowstone River with natural gas.

A daily newspaper is published in Miles City; Forsyth and Hysham support weekly newspapers.

Telephone service to the Middle Yellowstone subbasin is supplied by Class A (having annual revenues greater than $250,000) investor-owned facilities and by independent telephone companies.

Two Miles City stations transmit or relay television programming into the subbasin. The two Billings television stations are relayed to Miles City. Miles City has a 250 watt radio station.

The economic growth rate of Montana has been less rapid than in the surrounding states. The basin's economic problems are characteristic of an economic shift from farming to industry. As agriculture, the long-standing primary industry, grows relatively less important, industries once secondary in the economy must replace it. Agriculture of the basin has strength and pliability; new techniques are available, operations are larger, and automation is growing. Thus its contribution to a stable economy is expected to continue. The Middle Yellowstone subbasin is receiving long-range development to offset the decline of agriculture. New jobs, especially in the newly perfected uses of coal, will help stem the migration of labor to other areas. This requires new investments and new capital and changes in emphasis on exploitation of natural resources. The magnitude of investments for this change alone will be in the hundreds of millions of dollars.

Recreation and Fish and Wildlife

In a 1966 study, the State of Montana found that 17 percent of its tourists were going to Yellowstone National Park and 7 percent to Glacier National Park. Motels, hotels, restaurants, and gasoline service stations benefit from traffic en route to Yellowstone Park.

Tourists and local residents enjoy a variety of activities in the Middle Yellowstone, including hunting, fishing, sight-seeing, archeology, and rock-hounding among the agate beds around Miles City. Generally, however, the Middle Yellowstone is not a tourist destination area.

Wildlife is a most important recreational resource. Of fishermen and hunters, residents spend an average of $271 per person, non-residents $157 per person. In 1962 hunters and fishermen, 4,500 residents and 325 non-residents, spent about $1.5 million in the Middle Yellowstone Area.

Sir George Gore was probably the first recreational hunter locally. He hunted for a little less than two years, 1854-1856 in the Tongue, Powder and Yellowstone River drainages. According to Alfred J. Vaughan, Indian Agent for the Upper Missouri, Gore in that period killed "105 bears and some 2,000 Buffalo Elk and Deer 1,600".

Civilization, "sportsmen" such as Gore, and hide hunters eliminated buffalo, elk, big horn sheep, and bear from the Middle Yellowstone but hunting still remains important for antelope and mule and white-tailed deer. In 1967, about 3,500 resident and 150 non-resident big game licenses were sold in the subbasin's three largest counties. Big game areas are shown in figure 27 A and B.

Upland game bird hunting is also popular. Sage grouse, sharptail grouse, and pheasants annually attract more than 1,000 hunters to the fields. In addition, approximately 175 turkey permits are available. Game bird hunting areas are shown in figure 27 C.

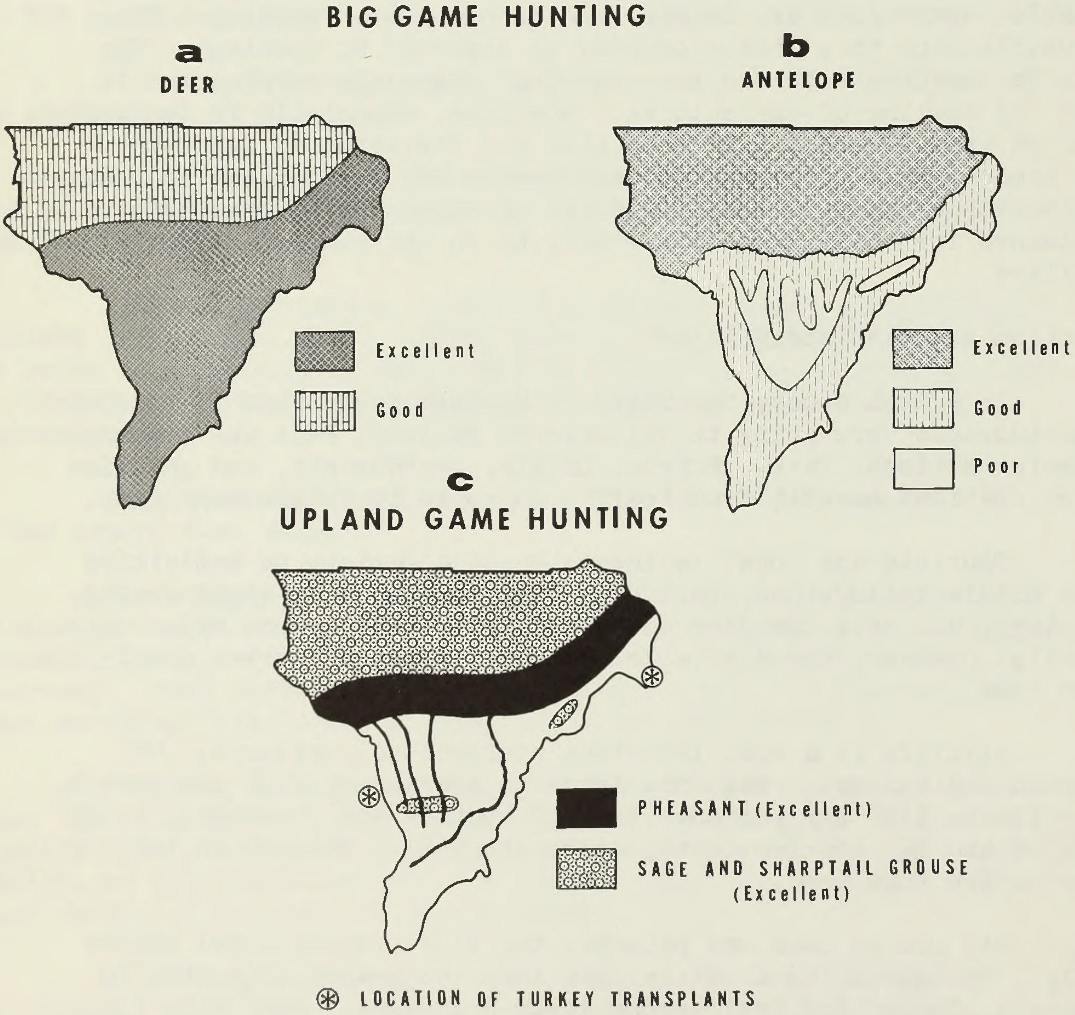


Figure 27

Fishing in the subbasin is confined to the Yellowstone River. At this point in its flow, the silt laden waters with higher temperatures have reduced the stream to one of local importance for fishing. Fishing for sandpike or sauger, catfish, ling and paddlefish is popular;

sandpike is probably the fish most commonly taken. Recently, local interest has centered on fishing for paddlefish. This unusual fish exists only in the Mississippi River and its tributaries, and the Yangtze River of China. Paddlefish must be caught by snagging, as they feed only on minute organisms in the muddy bottom of the river. Paddlefish have been caught as far upstream as Forsyth.

The subbasin lies on routes affording access to National Parks and Monuments such as Yellowstone and Glacier Parks, Custer Battlefield National Monument, Yellowtail Reservoir, and the scenic canyon of the Big Horn River. See appendix B for campsites, etc.. The Northern Cheyenne Indian Reservation and the agate beds on the old terraces of the Yellowstone River attract many tourists, amateur archeologists and geologists. North of Miles City, fossil trees lie buried in the red clays and thrust out high overhead from arroyo walls. Figure 28. Here fossilized leaves are buried in sandstone as concretions so unusual that only one other locality in the United States has similar forms.

Miles City leads in attracting tourists. Swimming pools, one conforming to requirements for Olympic competition, water skiing and a relaxed western atmosphere all contribute. Forsyth also offers water skiing on the Yellowstone River and attractive picnicking areas. Figure 29.

Tourism and its associated recreation is a definite factor in the economy of the subbasin, relying generally on extensive use of the open spaces. Campsites and picnic areas are given in appendix B; significant birds and mammals are also noted.

SEMIPRECIOUS GEMSTONES

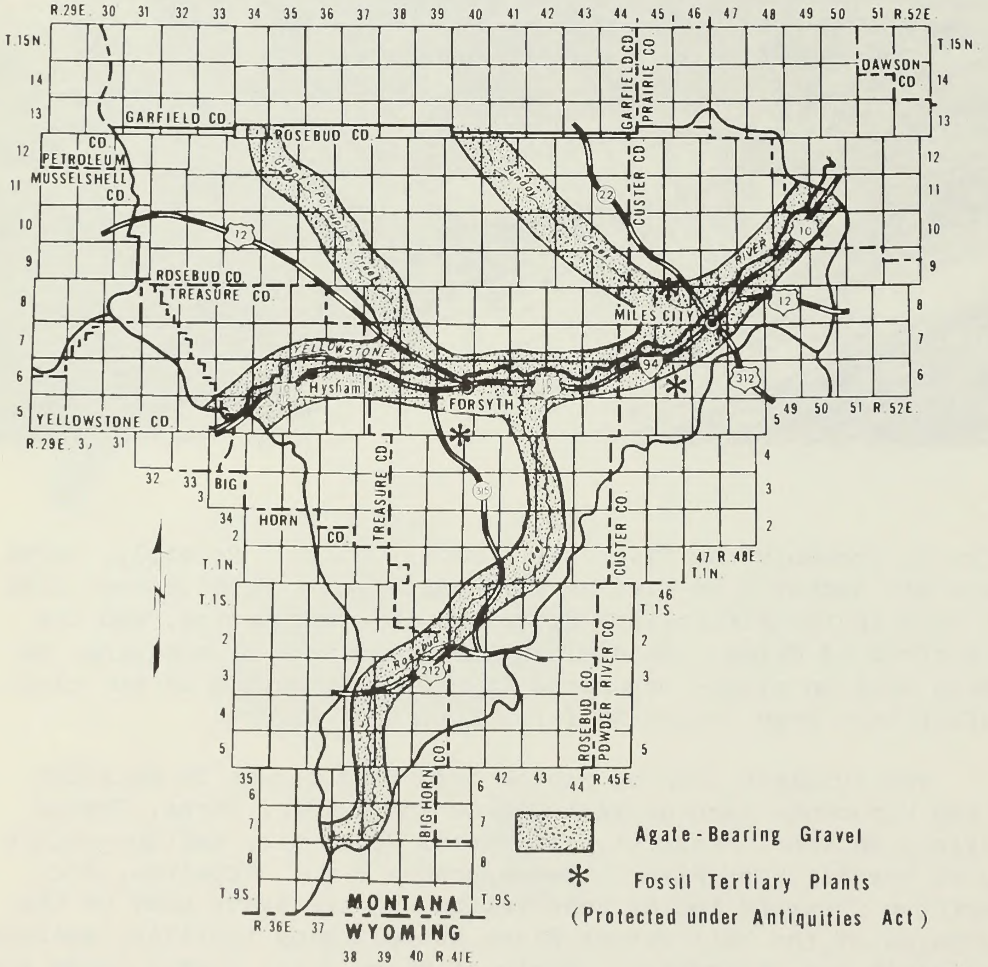


Figure 28

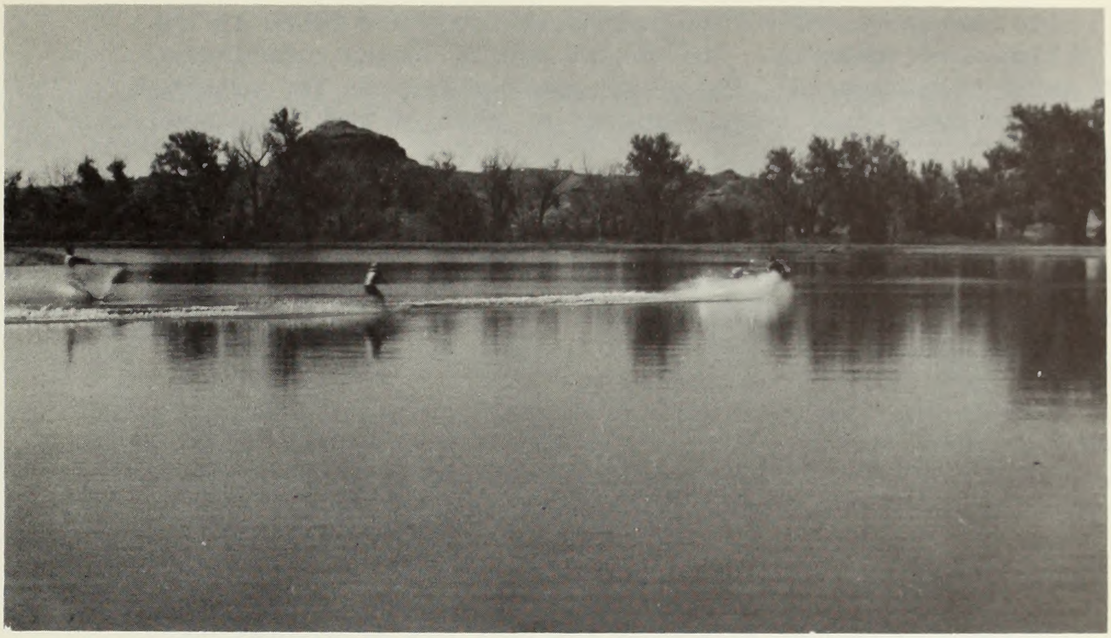


Figure 29 Recreational site developed through the cooperative effort of Federal and State agencies and the people of Miles City, Montana. Spotted Eagle Recreation Area - BLM.

THE PUBLIC LANDS

Characteristics and Administration

Three hundred and forty-four thousand acres of public land are administered by the Bureau of Land Management in the Middle Yellowstone River subbasin. (See maps in back envelope) The use and disposition of these lands is governed by the Taylor Grazing Act of June 28, 1934, (48 Stat. 1272; U. S. C. 315), as amended, and other applicable public land laws; a recent law of marked significance in their administration is the Multiple Use Management Act of September 19, 1964, (78 Stat. 988).

These are federal lands, originally acquired under the Louisiana Purchase. The small acreages lying in a scattered pattern throughout the basin are called isolated tracts. By definition of the Taylor Act, an isolated tract contains not more than 1,520 acres. Larger contiguous acreages are not considered to be isolated.

Administration of the public domain in the Middle Yellowstone River system is the responsibility of the Bureau of Land Management State Director at Billings, Montana. On-the-ground supervision and management are provided by the District Managers and their staffs at Miles City, and Billings, Montana, for the areas within their respective districts.

Two categories of BLM-administered lands are found in the Middle Yellowstone subbasin. The vacant public domain comprising 298,000 acres predominates. This land has remained in its original federal status ever since being acquired as part of the Louisiana Purchase.

The other land category is the Land Utilization or LU lands. These lands had once passed to private ownership, and were used in part for farming. They were utilized beyond their capabilities in most cases with resultant deterioration and economic hardship to the owners. Repurchased by the Federal Government during the drouth years of the 1930's, the LU lands are now administered under rules set by Congress which are somewhat different than the rules governing the ordinary vacant public domain. The LU lands consist of a 44,000 acre concentration in the eastern portion of the Yellowstone subbasin, and 2,000 acres in the extreme west.

Early Agricultural Land Classification (Circa 1924)

In the interest of promoting the best use of natural resources, the U. S. Geological Survey, in 1924, began a reconnaissance study of the agricultural capabilities of the Northern Great Plains. The plains were placed in three potential use classes; irrigation farming, dry-farming, and grazing. Dry-farming lands in turn were subdivided into one of three subclasses; farming, farming-grazing, and grazing-forage lands. Grazing lands had two subclasses, tillable and non-tillable; timber was included under "grazing, non-tillable". National Forests and National Parks were not classified.

Standards for these land classes by soils, topography and productivity are given in appendix C of this report. The Geological Survey statements concerning vegetation, soils, crop suitability and land classification as found in appendix B, are still generally applicable. The vegetation has changed moderately, the soils hardly at all.

The Northern Great Plains Study Report containing the Geological Survey Findings, was printed in 1929 in mimeograph form in relatively few copies. The accompanying map extracted for the Middle Yellowstone subbasin in figure 30 summarizes the Geological Survey classification.

Land Capability

Land capabilities recognize the uses to which all land can be put but express only the most productive use and the limitations of the lands for long-time, safe, economical production. These capabilities are expressed in eight classes, determined by soil depth and texture, fertility, the degree of slope, length of slope, susceptibility to erosion, as these are balanced against long-term production without soil damage. Figure 31.

Figure 30

GENERALIZED SUMMARY OF EARLIEST OVERALL LAND CLASSIFICATION OF

MIDDLE YELLOWSTONE RIVER AREA

Circa 1924 by U.S. Department of the Interior, Geological Survey

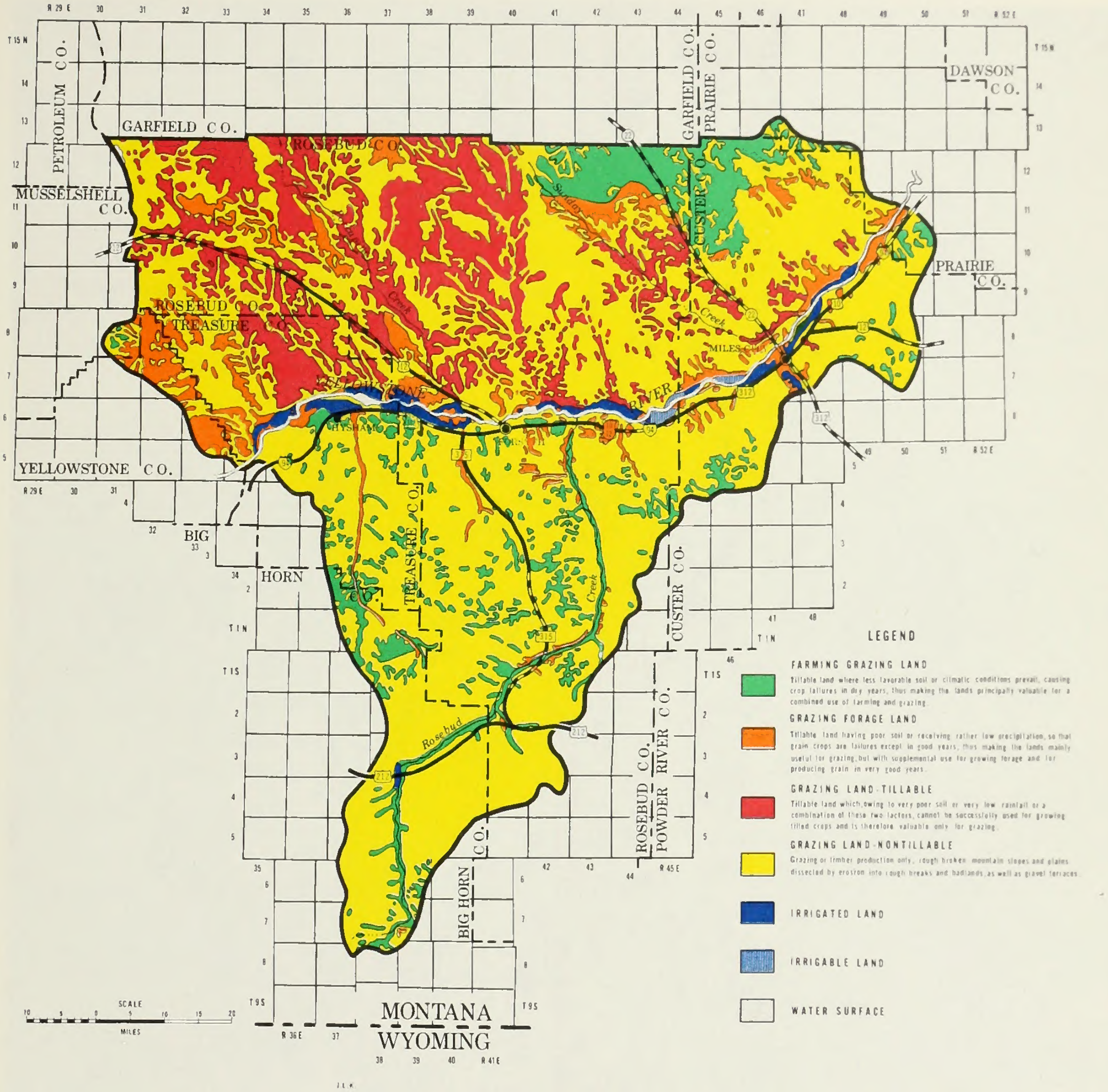
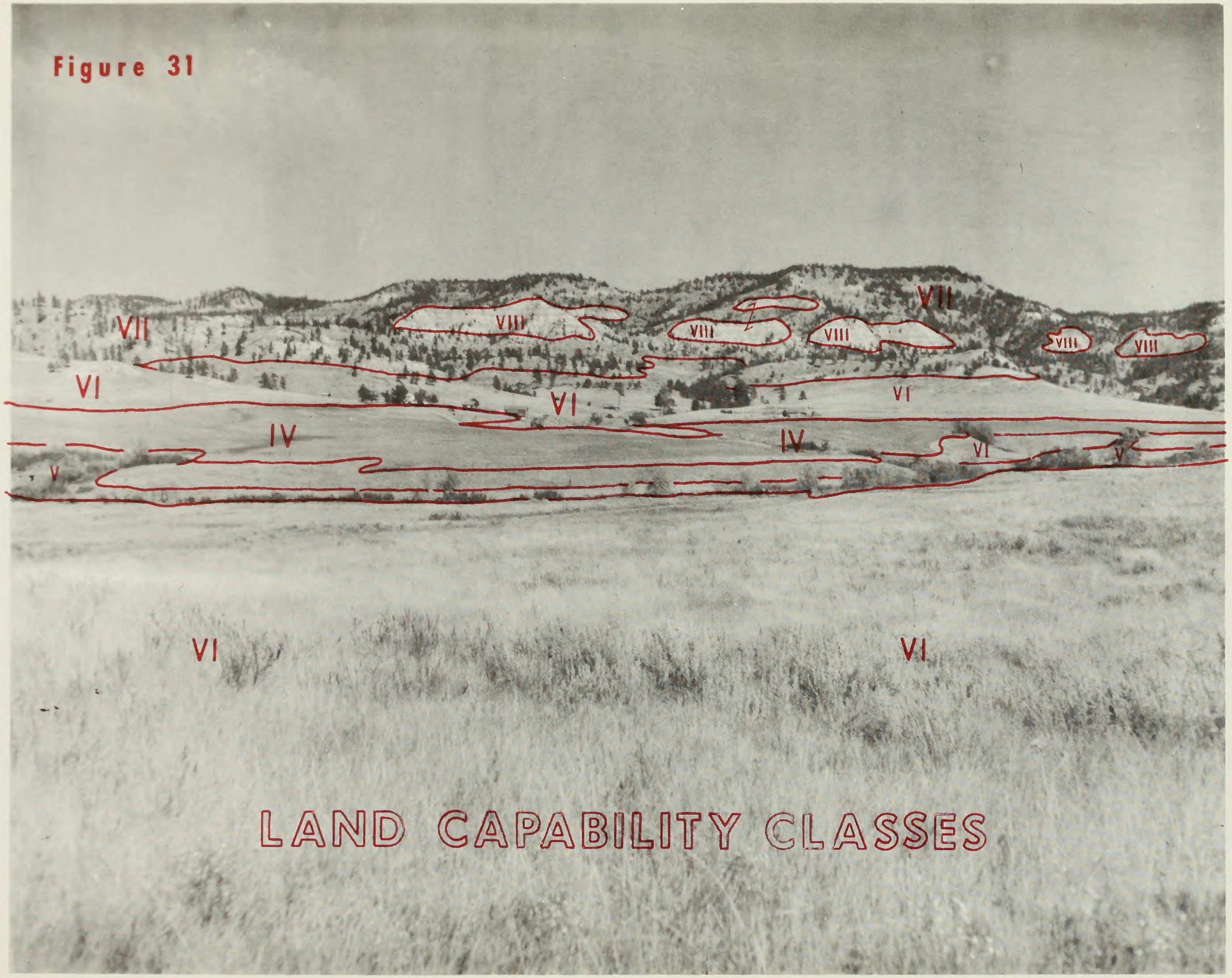

PETROLEUM CO.
GARFIELD CO.
MUSSELSHELL CO.
ROSEBUD CO.
TREASURE CO.
YELLOWSTONE CO.
BIG HORN CO.
CUSTER CO.
PRAIRIE CO.
DAWSON CO.
POWDER RIVER CO.
MONTANA
WYOMING
YELLOWSTONE RIVER
Rosebud Creek
Sunday Creek
Armells Creek
HYSHAM
FORSYTH
MILES CITY
T 15 N
T 1 N
T 1 S
T 9 S
R 29 E
R 36 E
R 41 E
R 45 E
R 52 E
SCALE
10 5 0 5 10 15 20
MILES
LEGEND
FARMING GRAZING LAND
Tillable land where less favorable soil or climatic conditions prevail, causing crop failures in dry years, thus making the lands principally valuable for a combined use of farming and grazing.
GRAZING FORAGE LAND
Tillable land having poor soil or receiving rather low precipitation, so that grain crops are failures except in good years, thus making the lands mainly useful for grazing, but with supplemental use for growing forage and for producing grain in very good years.
GRAZING LAND-TILLABLE
Tillable land which, owing to very poor soil or very low rainfall or a combination of these two factors, cannot be successfully used for growing tilled crops and is therefore valuable only for grazing.
GRAZING LAND-NONTILLABLE
Grazing or timber production only, rough broken mountain slopes and plains dissected by erosion into rough breaks and badlands, as well as gravel terraces.
IRRIGATED LAND
IRRIGABLE LAND
WATER SURFACE
J.L.K.

Figure 31



LAND CAPABILITY CLASSES

Cultivable soils are found in Classes I, II, III and IV. Class I soils are deep, level, fertile, and grow any agricultural crop within the limits of prevailing climate. Class II soils require a few precautions in farming to protect the soil from erosion, and maintain the tilth and level of fertility. The higher the class number, the greater is its associated management problem. Soils of Class IV, in the Middle Yellowstone River Area, include those on the dryland farms where fallow land and strip cropping produce crops within the limits of local climate.

Land capability Class V falls between those soils suited to cultivation and soils suited only for permanent plant cover. Class V lands may be level with deep soils, but are not cultivable for such reasons as frequent river overflow or rockiness.

Most of the lands in the Middle Yellowstone River Area, especially BLM administered lands, have soils which must be kept in permanent plant cover. The best of these lands are in Class VI where the level, relatively deep and fertile soils require only good range or timber management practices for continued use. Class VII includes those soils with increasing hazards of use due to steeper topography, shallow soils, soils with unstable texture, or a concentration of salts. Rangeland in Class VII is restricted to lighter grazing than is Class VI land.

Class VIII land includes marshes, steep rugged mountains, and barren badlands. Wildlife values and associated recreational uses are often high.

Approximately 84 percent (249,000 acres) of the public domain is so rough and mountainous, excessively rolling, or saline that use by livestock must include careful regulation of stocking rates and other protective management methods. These are Class VII capability lands. Roughly 14 percent (41,000 acres) are adapted to livestock production without significant restrictions and placed in Class VI capability. Another 2 percent (6,000 acres) can only be used by wildlife, and less than 1 percent would be in Classes I, II, III or IV and cultivable. The acquired Land Utilization lands which were once private, have higher capability than the public domain, with 54 percent in Class VI, 45 percent in Class VII and 1 percent in Classes I through V. Figure 32.

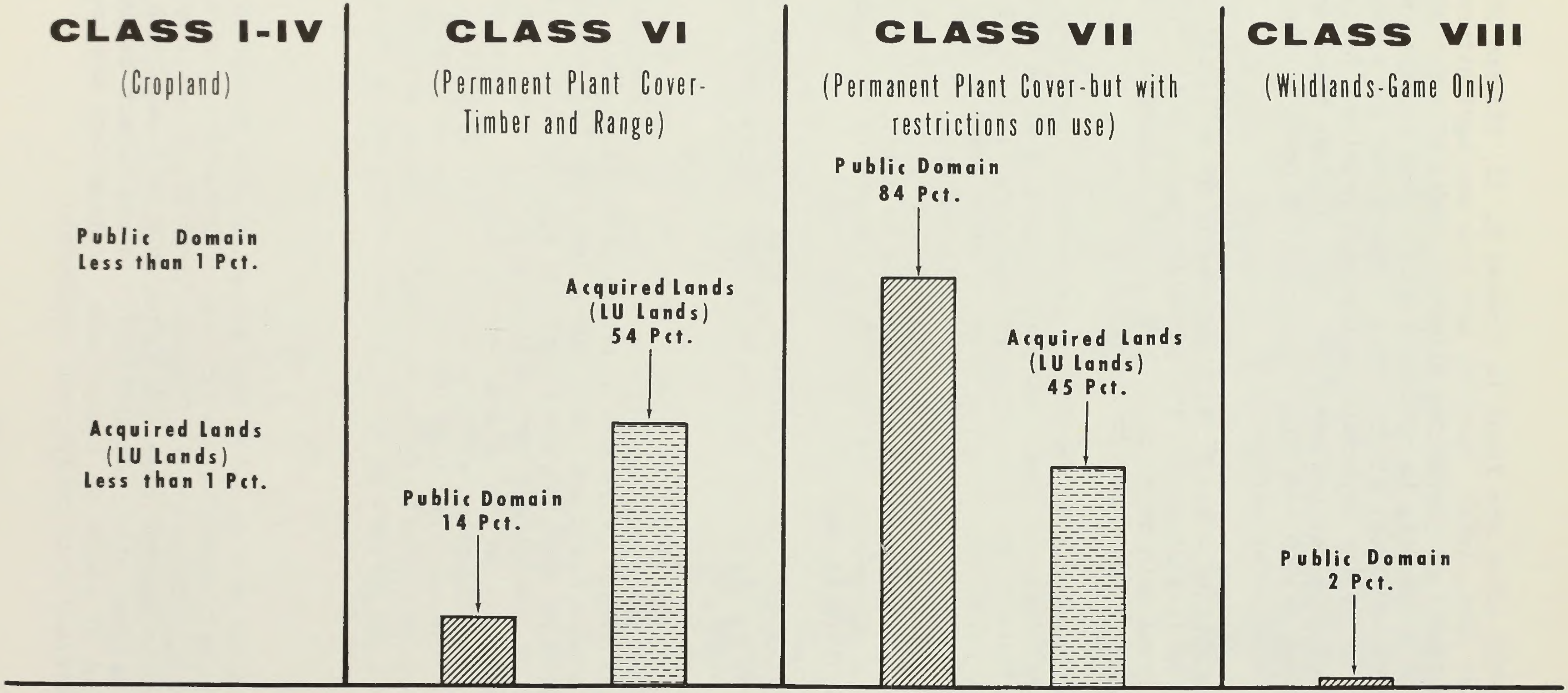
Range Vegetation

Range lands are mapped by the Bureau of Land Management according to general vegetative aspect, which is derived from dominant plants. Figure 33. There are 18 Standard Range Types based on aspect. Range Types carry a general name and number such as 4-sagebrush, 1-grassland, 2-meadow, etc.. (Appendix C). If one aspect is dominant but another group of plants is conspicuous, combinations are used such as 1-4 grassland with conspicuous sagebrush.

Figure 32

LAND CAPABILITIES

MIDDLE YELLOWSTONE RIVER AREA



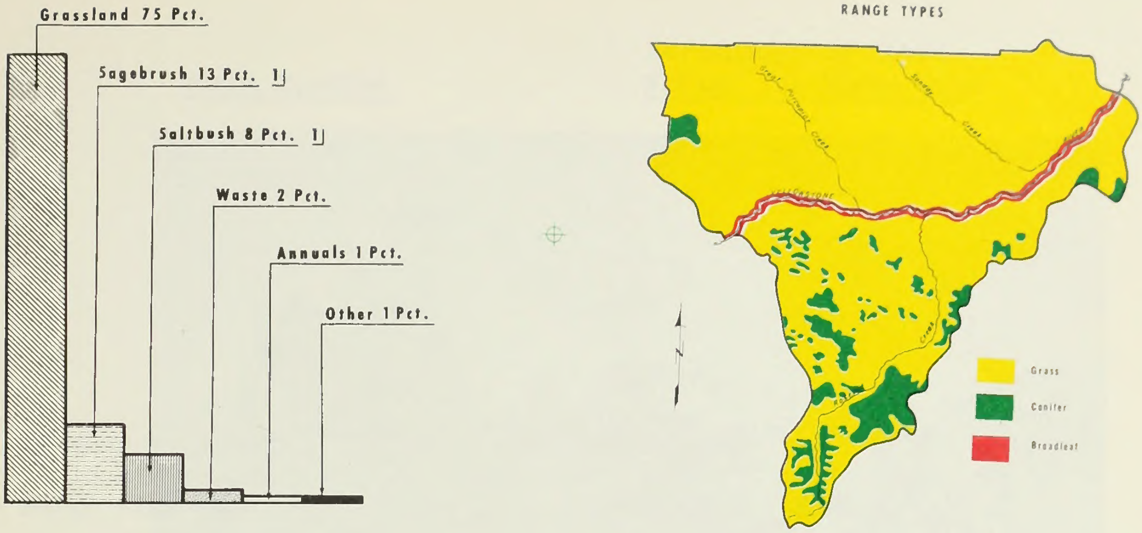


Figure 33 Range Types of the Middle Yellowstone Area

1/ These are subtypes of grassland with a conspicuous but sparse shrub stand.

Perennial grassland is the largest range type on vacant lands of the Middle Yellowstone Area with 223,000 acres, or 75 percent of the land. Figure 34. Sagebrush is conspicuous on 38,000 acres of grassland (13 percent); Gardner saltbush is conspicuous on 24,000 acres of grassland (8 percent); waste (plant cover not available to livestock) covers 5,000 acres or 2 percent, and annuals cover 2,000 acres or 1 percent. The remaining 1 percent are minor acreages of greasewood, halfshrubs, conifer, timbered bottomland, and rock. Figure 35.

Figure 34 Southern part of the Middle Yellowstone Area showing Range Type-1 grassland in excellent condition.

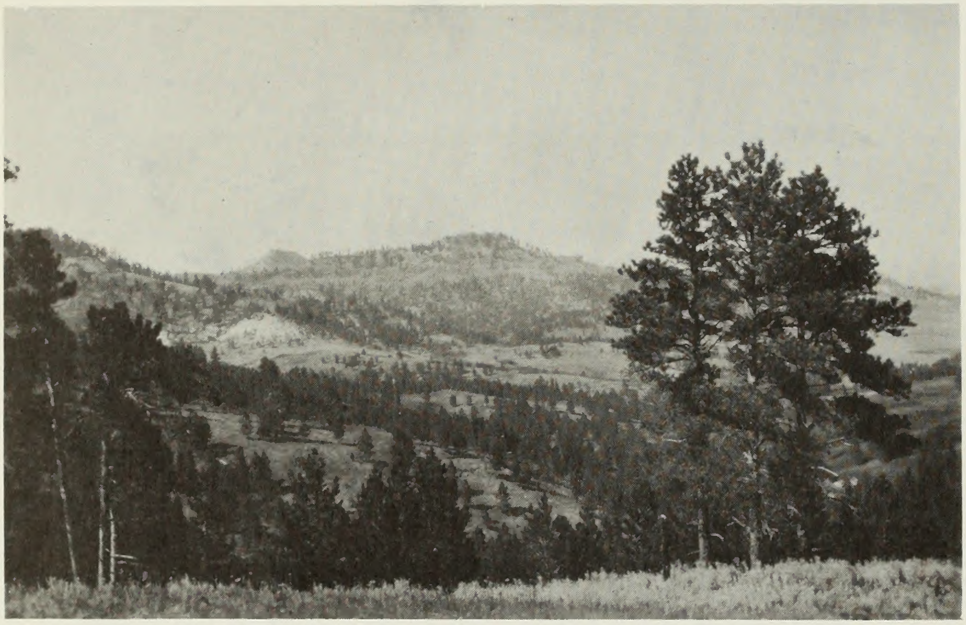


Figure 35 The terrain and tree cover is typical of the Wolf Mountains in the central subbasin. (U. S. Geological Survey Photograph)

Range Evaluation (Inventory details are in Appendix C)

In evaluating range vegetation each plant was listed by its frequency of occurrence. A frequency listing shows only one fact, that a plant has occurred in a writeup regardless of quantity of forage produced.

Some plants will dominate the vegetation by sheer bulk of forage. This production is most significant in deciding their value. Each plant was estimated as to the percentage it made up of the total vegetation of a range site. Fifteen percent of total forage is the breakoff point for evaluating the relative importance of the individual species. Plants making up less than 15 percent were excluded as not significant.

Determination of both plant frequency and significant relative forage production is derived in the example that follows which is a simplified forage description for one range site. (The total of such descriptions for the subbasin was 754.)

Plant Species	Percentage of Total Forage for Range Site
Blue Grama	25%
Sand Dropseed	10%
Western Wheatgrass	5%
Prickly Pear	T (any amount less than 5%)
Big Sagebrush	60%
Total	100%

Frequency: Each of the above plants has a frequency of one - i.e. it is listed once on this range site. If it were listed on every range site writeup (754) it would have 100 percent frequency.

Significant production: From examination of the inventory, 15 percent of the total forage production appeared as the most useful breaking point for determining relative importance of species. Using this criterion in the above example, blue grama with 25 percent and big sagebrush with 60 percent are the only plants with significant production.

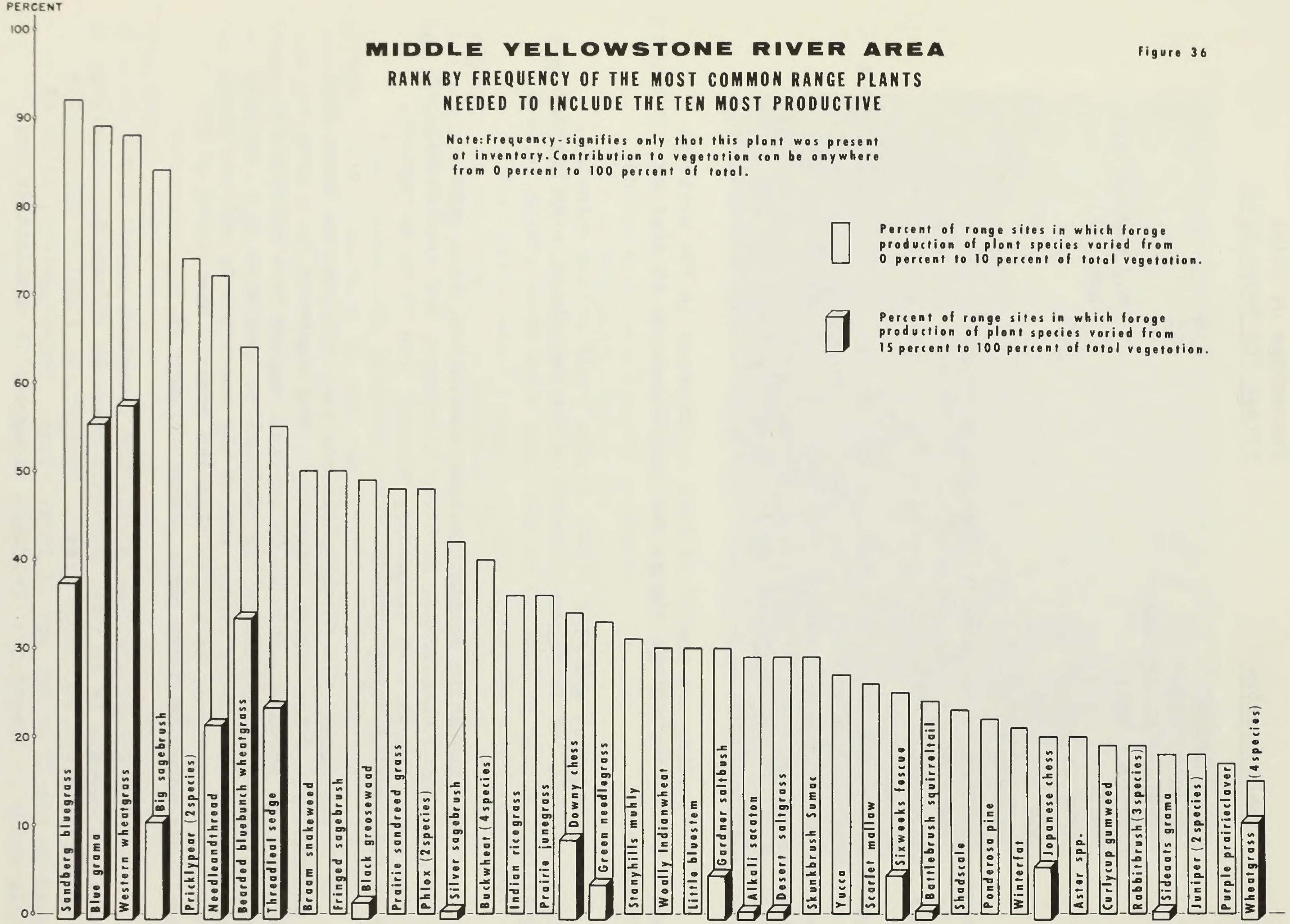
Totaling the number of such occurrences in 754 writeups gives a useful percentage figure for comparisons as it does in frequency.

Frequency and significant forage yield seldom coincide. This is brought out in figure 36 showing the ten plants with highest significant forage production as they rank with other plants in order of frequency.

On the public domain, western wheatgrass, blue grama, bearded bluebunch wheatgrass, Sandberg bluegrass, and needleandthread are the most important in frequency, varying from 55 to 94 percent, and in substantial forage yields.

The value of a forage plant may vary for reasons other than an abundant yield and a high frequency. Big sagebrush is a good example. Its frequency rate of 84 percent coupled to a substantial forage yield on 11 percent of the range sites indicates it to be only fairly important. Heavy winter use of big sagebrush by cattle, sheep and wildlife, however, at a time when the grasses have cured or are unavailable makes it a key range plant. Figure 37.

Some plants are unpalatable and livestock reject them. Sandberg bluegrass is an example. This grass is widespread occurring on 92 out of every 100 range sites. Further, it supplies appreciable forage on nearly 40 percent of these sites. Unfortunately, it is of little value to livestock. Sandberg bluegrass is unpalatable and



MIDDLE YELLOWSTONE RIVER AREA

RANK BY FREQUENCY OF THE MOST COMMON RANGE PLANTS NEEDED TO INCLUDE THE TEN MOST PRODUCTIVE

Figure 36

Note: Frequency-signifies only that this plant was present at inventory. Contribution to vegetation can be anywhere from 0 percent to 100 percent of total.

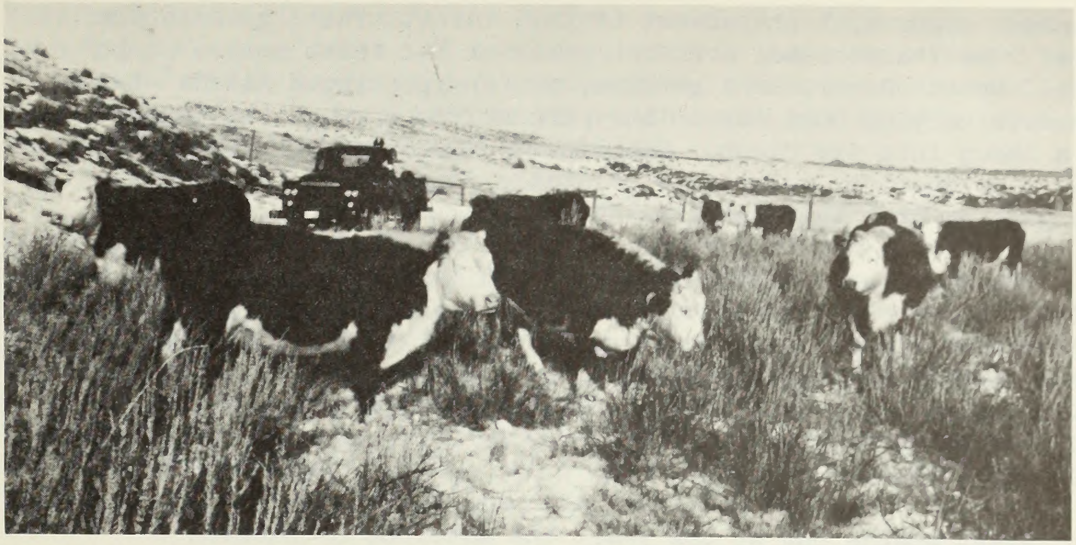


Figure 37 Cattle wintering on sagebrush on the experimental range of the U. S. Department of Agriculture, Range and Livestock Experiment Station, Miles City, Montana. (U. S. Department of Agriculture Photograph)

and also short; it cannot be grazed much closer to the ground than its normal ungrazed height. Surprisingly, Sandberg bluegrass does not take over the range. Its chance came with the drouths of the 1930's, when major forage-producing grasses dropped from 28 percent to 2 percent of the ground cover in the 4 years from 1933 through 1937. Sandberg bluegrass increased by 1938 to occupy $4\frac{1}{2}$ times the area it covered in 1933. With the return of normal rainfall, major grasses began to successfully compete with Sandberg bluegrass and in 5 years (1938-1943) reduced it to its 1933 level.

Figure 36 shows the principal forage grasses of the Middle Yellowstone Area to be western wheatgrass, blue grama, bearded bluebunch wheatgrass and needleandthread.

Blue grama is a short grass, productive and palatable. It begins growth in late April and cures in late July and August. In normally moist years it not only bears up under heavy use but increases its area of distribution. Like Sandberg bluegrass, blue grama escapes much of the grazing pressure by its low growth habit. With excessive grazing pressure, taller grasses bear the heaviest utilization; as they weaken and disappear, blue grama will move into their former sites.

Western wheatgrass, bearded bluebunch wheatgrass, and needleandthread are mid-grasses. Their growth starts late in March or early April and stops between late June and mid-August; it resumes with lessened vigor with the advent of fall rains. These grasses are palatable. Needleandthread, a common grass on the sheep ranges north of the Yellowstone River, is a problem; its sharp pointed "seeds" twist and turn with varying humidity to bury themselves through the dense wool of a sheep into its flesh. Despite its disadvantages, needleandthread is a productive, relatively palatable plant, more resistant to heavy grazing than the wheatgrasses.

Big sagebrush, silver sagebrush and fringed sagebrush, a low half-shrub, are key shrubs totaling 177 percent frequency; this means one or two species occur on every range site. The most productive shrub species was big sagebrush. On 11 percent of the range sites it produced 15 percent or more of total forage yield. Silver sagebrush and fringed sagebrush did not reach 15 percent of the total yield for any site.

Eight months out of the year, the antelope of eastern Montana live principally on these three shrubs. Big sagebrush and silver sagebrush are also used heavily as winter feed by cattle and sheep; during the summer, silver sagebrush is used by cattle. Fringed sagebrush, although valuable to wildlife is unpalatable to cattle and sheep and tends to increase on heavily grazed range. Big sagebrush and silver sagebrush decrease under light use and increase under heavier range use. However, the increase or decrease of these plants is related as much or more to weather cycles and the effect of soils, as to grazing pressures. None of these species is a range plant problem, and control measures are not desirable.

Weather regulates the numbers of both pricklypear cactus and annual plants. Severe grazing can result in an increase of these plants as the better forage species decline and disappear, but grazing intensity has less effect than the weather. Drouth will kill productive perennial forage plants, permitting the pricklypear to extend over the vacant ground, but with the return of cooler and damper years, pricklypear declines to normal levels.

Annual grasses come into prominence during a cool, wet spring following an extended drouth, but they fade when the perennial plants recover. Thus, annual plants vary with short-period climatic trends. The inventory of the Middle Yellowstone Area included one field season favorable to annual plant growth, at which times they were unusually prominent; see appendix B for the details. Annual grasses identified as eight-week fescue, downy brome, Japanese brome, little barley, and false buffalograss occurred on 92 out of 100 range sites, where they produced a minimum of 15 percent of the forage on 23 percent of the range sites.

Annual forb (weed) frequencies also ran high. The most common of these annual plants were, wooly Indianwheat, 41 percent frequency; annual sunflower, 15 percent; tumblemustard, 10 percent;

Russian thistle, 8 percent; and Nuttall monolepis, 7 percent. Out of every 100 range sites, 83 had annual forbs, but none amounted to 15 percent of the vegetation. Frequency and abundance of annual plants vary greatly from year to year with soils and climate having the greatest influence on this variability.

Noxious plants and plants of low palatability were found to be common on the Middle Yellowstone ranges. Fringed sagebrush and broom snakeweed were found on 50 percent of the range sites, and pricklypear on nearly 75 percent. None of these noxious plants ever yielded 15 percent of the forage on any range site, and usually they were in minor quantities. Pricklypear with a high frequency of 74 percent, and yucca with a frequency of 16 percent, are more often related to soils than to any other one environmental factor. Since the time of Larocque, in 1805, pricklypear has been noted by most of the explorers as being very common in the locality.

Poisonous plants are not a problem in the Middle Yellowstone Area. Cocklebur causes the most cattle losses; a few head die each year where cocklebur has established itself on raw soils such as in fresh alluvium deposited by summer floods. Figure 38.

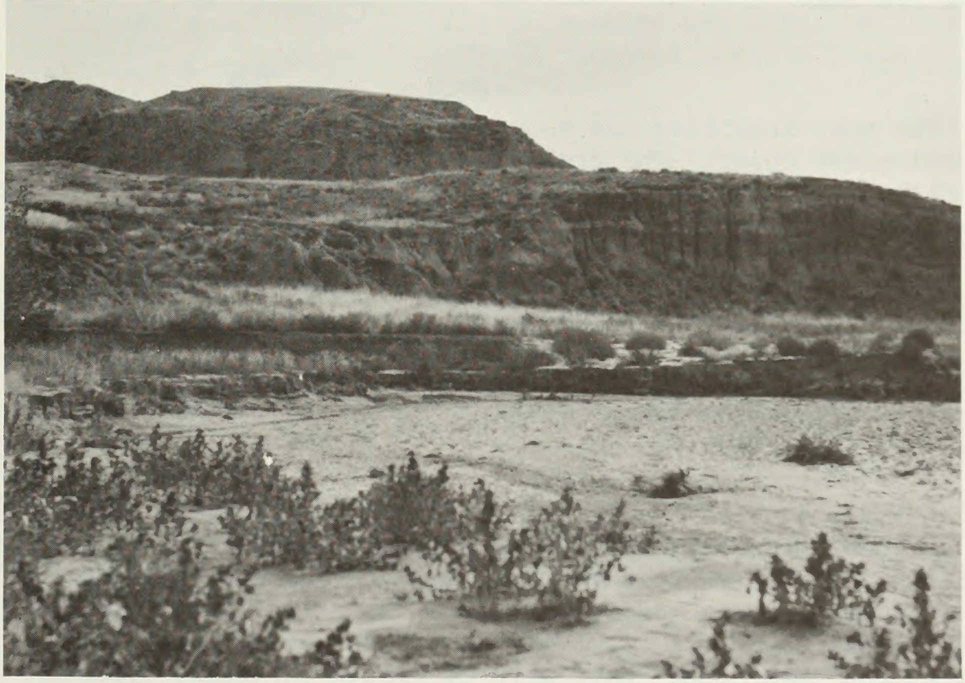


Figure 38 Intermittent stream north of the Yellowstone River. Cocklebur, in the foreground, is the area's most common poisonous plant. An annual, it usually grows on raw soils.

Black greasewood is the poisonous plant found most often, and in quantity, but no losses are reported. Death camas and arrowgrass, both very poisonous, are uncommon and no losses are reported. Some potentially poisonous plants, especially chokecherry and lupine, are commonly used by livestock and wildlife as forage. Lupine manufactures toxic alkaloids, but its toxicity varies seasonally and chokecherry is toxic only after a frost or severe drouth. Both species are grazed. Livestock loss for the subbasin is negligible and unreported.

Formerly, loco weed caused severe losses among work horses in the Middle Yellowstone subbasin. With the great decline in numbers of horses, however, and virtual eradication of the plant, livestock death from loco weed is almost unknown.

Livestock poisoning from range plants is most likely to occur when the animals are very hungry, such as in the wake of a prolonged storm. During drouth years, a lack of the normally desirable grasses may oblige livestock to graze on unpalatable and even on dangerous plants. The conditions which result in livestock poisoning are not normally encountered in the Middle Yellowstone area, partly because of quality range forage production and good livestock management systems.

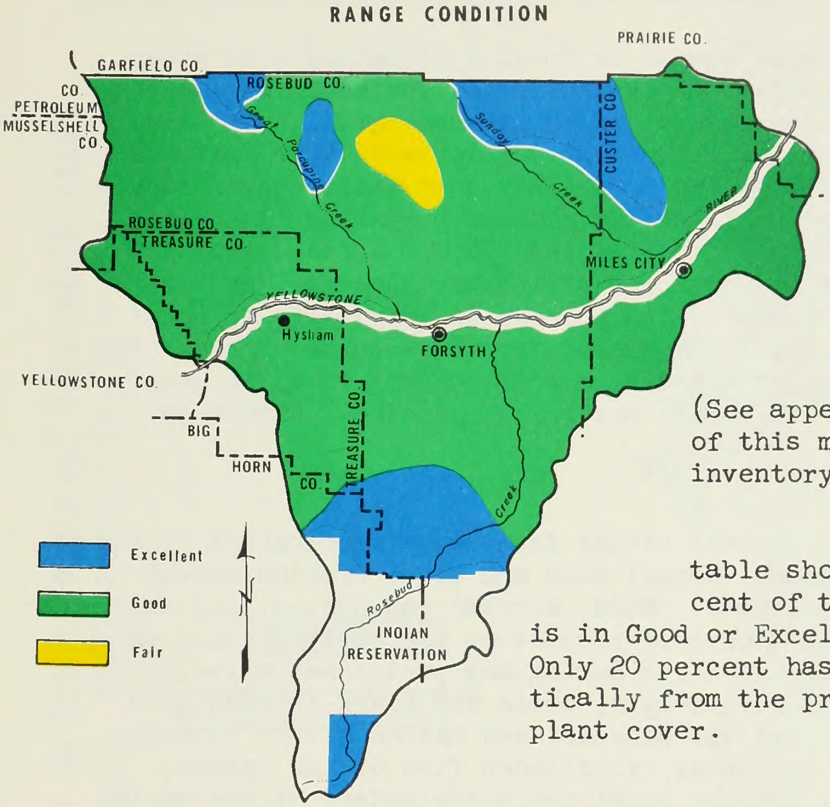
Range Condition

The most sensitive and accurate indicator of range condition is the total plant cover. The ecological method which is used in this inventory, evaluates plant cover by range sites - mappable areas with significant differences in soil depth, soil texture, soil permeability, topography or forage production. The original plant cover for each range site is determined by studying protected and well-managed range lands. Condition can then be related to any departures (0%-100%) from the percentage of original plant species. Range condition is given as: "Excellent" (75% to 100% of original); "Good" (50% to 75% of original); "Fair" (25% to 50% of original); "Poor" (0% to 25% of original).

A range site in "Excellent" condition is in close accord with its original plant cover. The next lower class, "Good" represents small changes in which some percentage of the original plants have been changed. Lower condition groups "Fair" and "Poor" represent greater departures from the original plant cover. On typical range "Excellent" and "Good" have more desirable perennial grasses and forbs; forage production is greater; the soil cover of mulch and litter will, however, vary with climate and site. In "Fair" and "Poor" condition, forage production is less because the plants are usually low-growing and many are rejected by livestock.

On "Fair" ranges, the plants may be inferior in quality or quantity to those of the original plant cover, but furnish forage at a season of critical need. Therefore, range in "Fair" condition may be necessary to the range managers.

RANGE CONDITION



"Poor" condition is the lowest condition class. The original plant cover may be replaced wholly or in part by other, often undesirable, vegetation. (See appendix C for details of this method of range inventory.)

The following table shows that 80 percent of the public domain is in Good or Excellent condition. Only 20 percent has departed drastically from the presettlement plant cover.

Excellent Condition	35 percent	105,000 acres
Good Condition	49 percent	146,000 acres
Fair Condition	15 percent	44,000 acres
Poor Condition	1 percent	3,000 acres

Weather is the most important determinant of range condition, range management follows - the two have worked together to produce this subbasin's generally favorable range condition. Note: Condition is not related directly to forage production. Badlands are often excellent but the site is so austere that forage production is extremely low. Compare the Carrying Capacity Map of figure 16 with the accompanying map giving general range condition of the subbasin.

Land Slope Comparisons

The slope of the land determines its microclimate and thereby its vegetation, its soil development, its susceptibility to erosion and to soil potential for production. Slope coupled to exposure affects the life form and species of plants and animals molding the entire ecology of the area.

Land capability is related to the slope of the land more often than any other single factor because of the influence of slope on the development of inherent land capabilities.

Most of the public domain is rough and shallow with steep slopes. It has no capability for agriculture. The acquired lands once privately owned and farmed proved to be submarginal crop land. After their return to federal management, these lands were restored to permanent vegetative cover and thereafter used within their capabilities. The difference in these two classes of public lands is apparent when we compare the slopes of the 298,000 acres of public domain with those of the 46,000 acres of acquired lands. The public domain has roughly 25 percent of its acreage in very hilly to mountainous country as compared to 9 percent for the acquired lands. The acquired lands, at the other extreme, are 37 percent level to gently sloping, whereas the public domain has but 17 percent. Figure 39.

Soil Erosion

Soil losses may result either from normal geological erosion, or from accelerated erosion. Normal wind and water erosion carved most of our existing landscapes. Muddy streams and dust-filled skies were as much a part of the scene of prehistory and early history as they are today. The Missouri River during any period has normally carried a big silt load. For example, Lewis and Clark in 1805 were delayed at the confluence of the Missouri and Marias Rivers in western Montana, because of the muddy, silt-laden flow of the latter. The two captains were obliged to scout the muddy waters of the Marias as well as the clear stream of the Missouri's true course, to insure that they were correct in leaving the brown waters they had ascended all the way from St. Louis. Captain Clark, in 1806 remarked in his journal that the Clark Fork River, though muddy, was the least turbid of the many tributaries to the Yellowstone.

The terrain of the Middle Yellowstone area is that of a level plain, downcut in several successive erosion cycles during which periods of rapid and slow cutting alternated. Differing rates of cutting and deposition are shown in the alluvial soils of a valley in figure 40. The original surface of the subbasin consists of relatively recent sedimentary deposits in the Cretaceous Period and the Eocene Epoch. Claystone, siltstone, sandstone and shales are the most common materials. Cliffs of sandstone, and badlands of clay and shale located north of the Yellowstone River, and mesas and buttes south of the river have peaks and ridge crests at the same average level of the earlier plain. Figure 41.

Differences in parent material account for local relief. The most pronounced relief is south of the Yellowstone River. Most of the higher land surface here is protected by beds of scoria, a hard, erosion-resistant slag. Below the scoria the slopes are steeper. Generally, differences in elevation are small.

Slope Classes by Percent for Public Domain and Acquired (LU) Lands

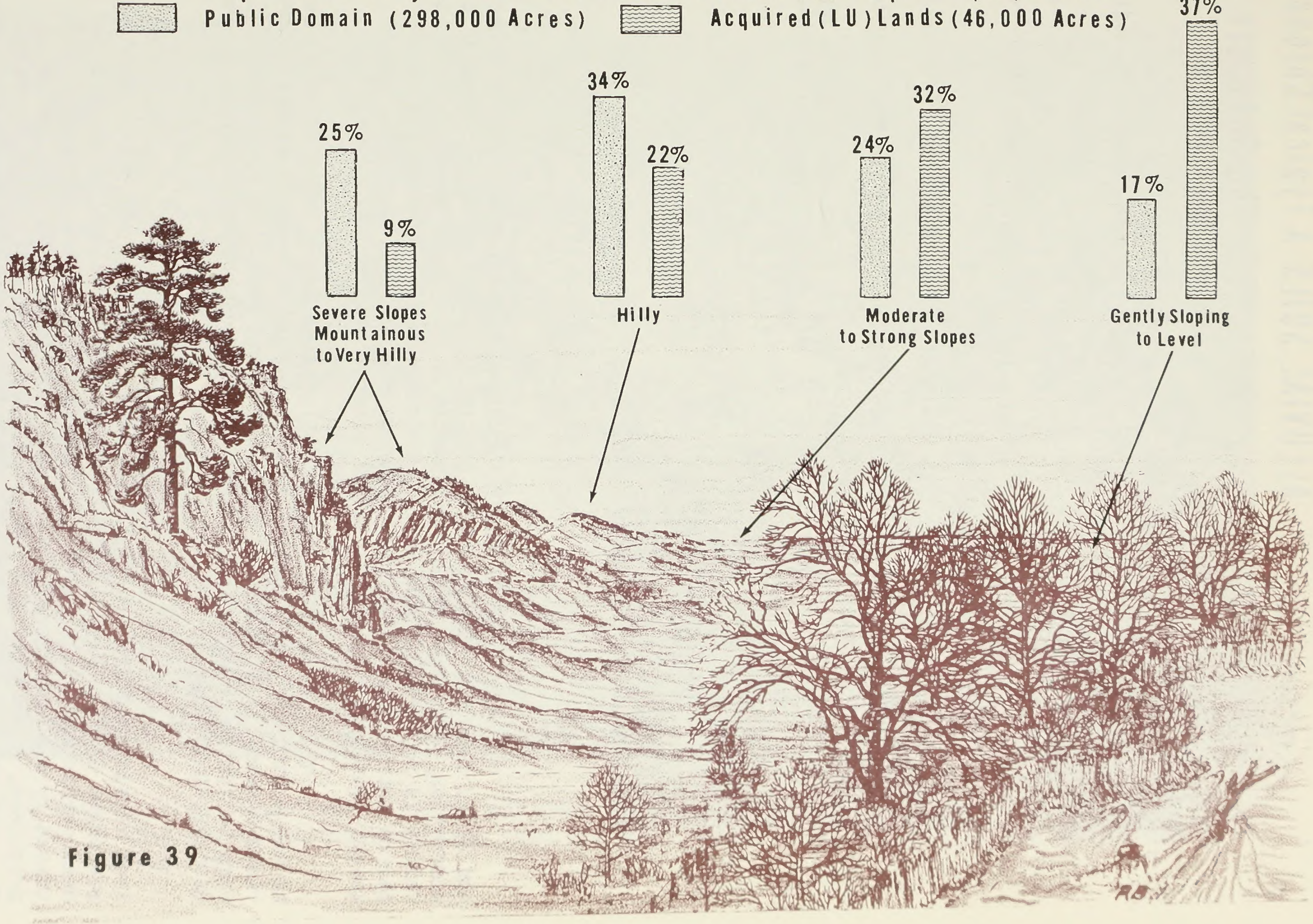


Figure 39

ALLUVIAL SOILS - A Typical Chronology of Deposits in the Subbasin

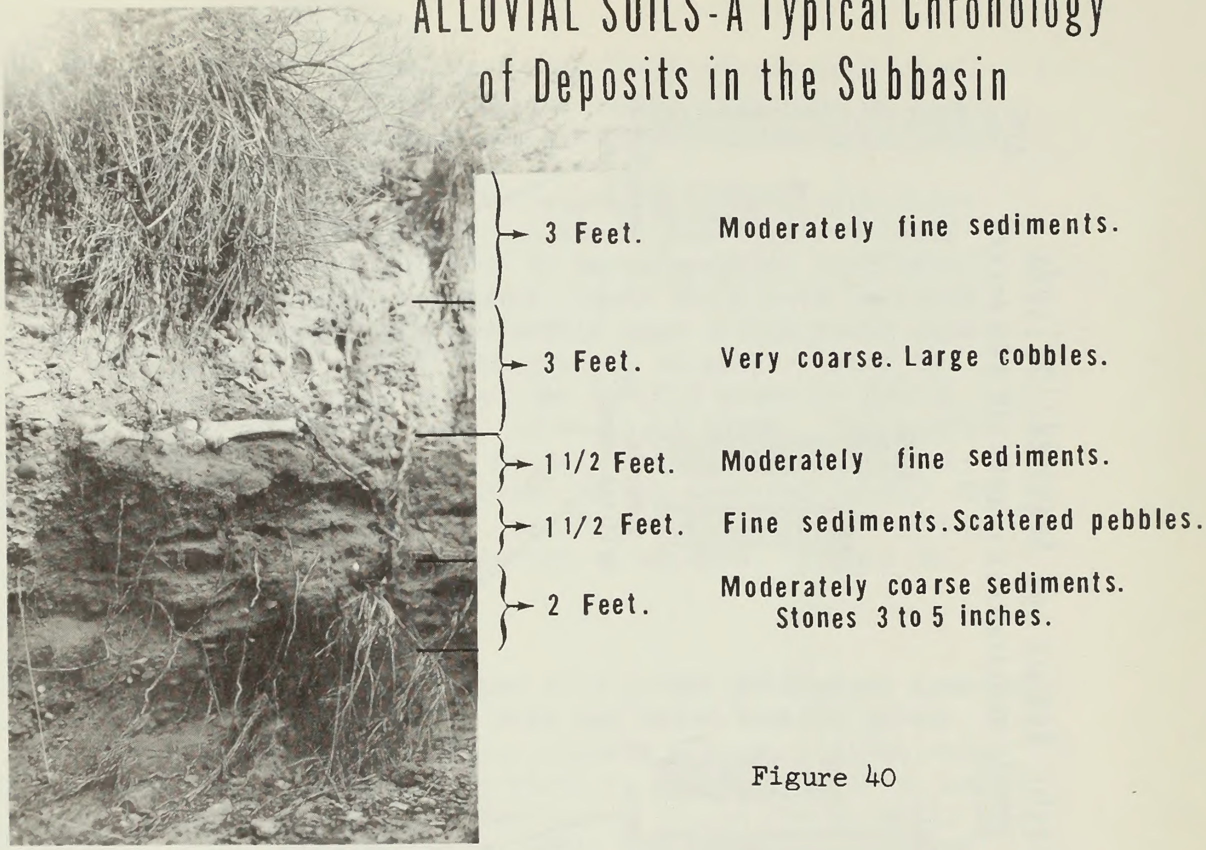

3 Feet. Moderately fine sediments.
3 Feet. Very coarse. Large cobbles.
1 1/2 Feet. Moderately fine sediments.
1 1/2 Feet. Fine sediments. Scattered pebbles.
2 Feet. Moderately coarse sediments. Stones 3 to 5 inches.

Figure 40

Valleys south of the Yellowstone River are relatively broad and flat; from the uplands their initial slope is steeply downward, then moderating, and finally becoming gentle as the local base level of the valley is reached. The main tributary drainages, usually lie in a narrow bottom incised a few feet below the valley floor. The narrow, lowest levels of the drainages are often stabilized by vegetation.

The plains north of the Yellowstone River differ from those to the south; many of the drainages in the north-central area are incised several feet below the general surface level. A good example is seen in figure 52 appendix B. These drainages are relatively wide and usually stabilized.

In addition to normal geological erosion, soil loss comes from accelerated erosion which may result from natural causes such as prolonged drouth, fires, mud slides, or any other way in which the soil surface is rendered bare. Usually, accelerated erosion is initiated by man through cultivation, over-grazing, improper lumbering practices, strip mining or other activities which destroy or weaken the protective vegetative cover. The basic restraint upon accelerated erosion is by use of a soil within the limit of its capability.

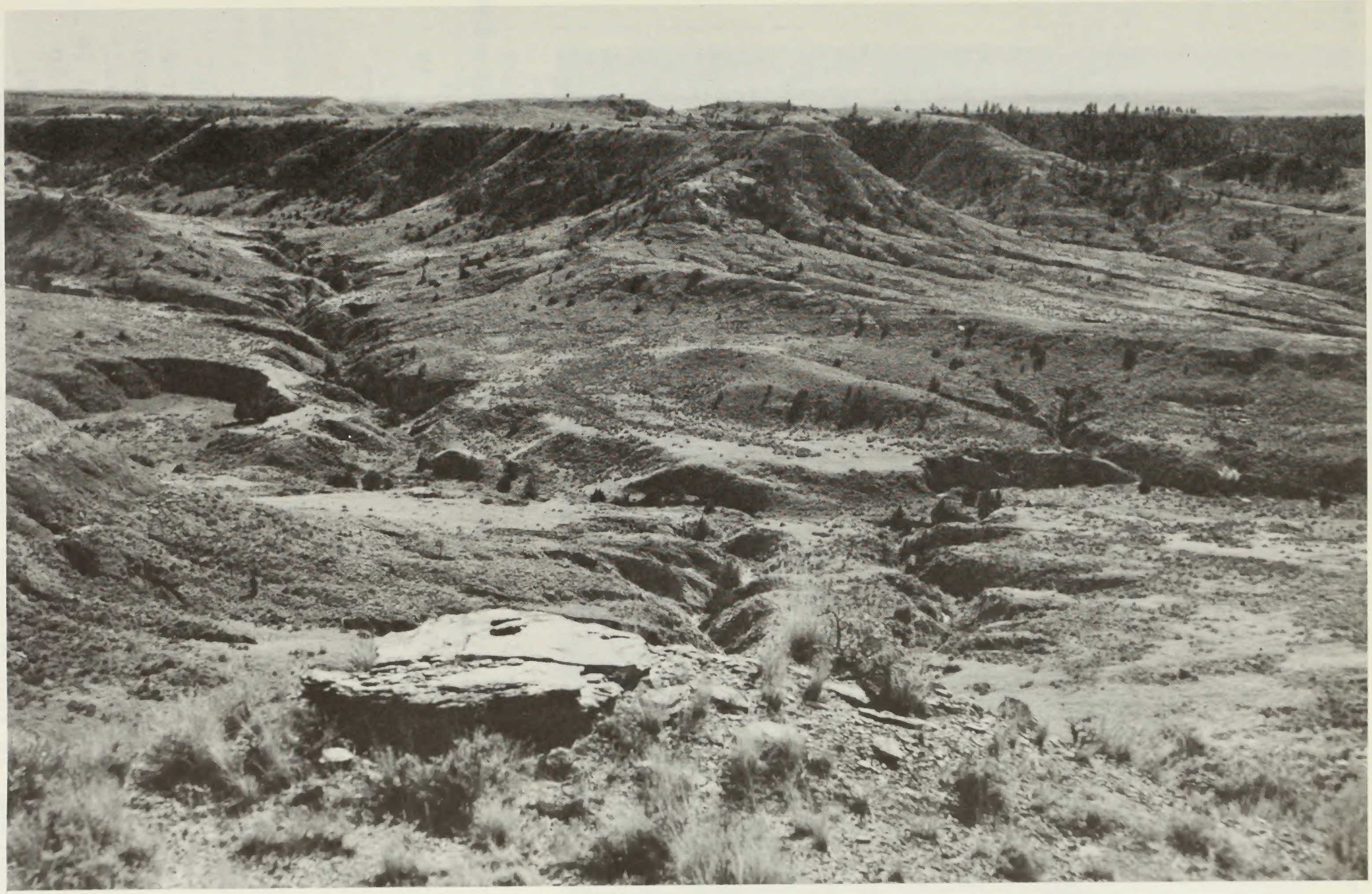


Figure 41 Cycles of geologic erosion are seen in the above photo in the various valley levels. The narrow valley resulting from the most recent erosion cycle is now stabilized by vegetation.

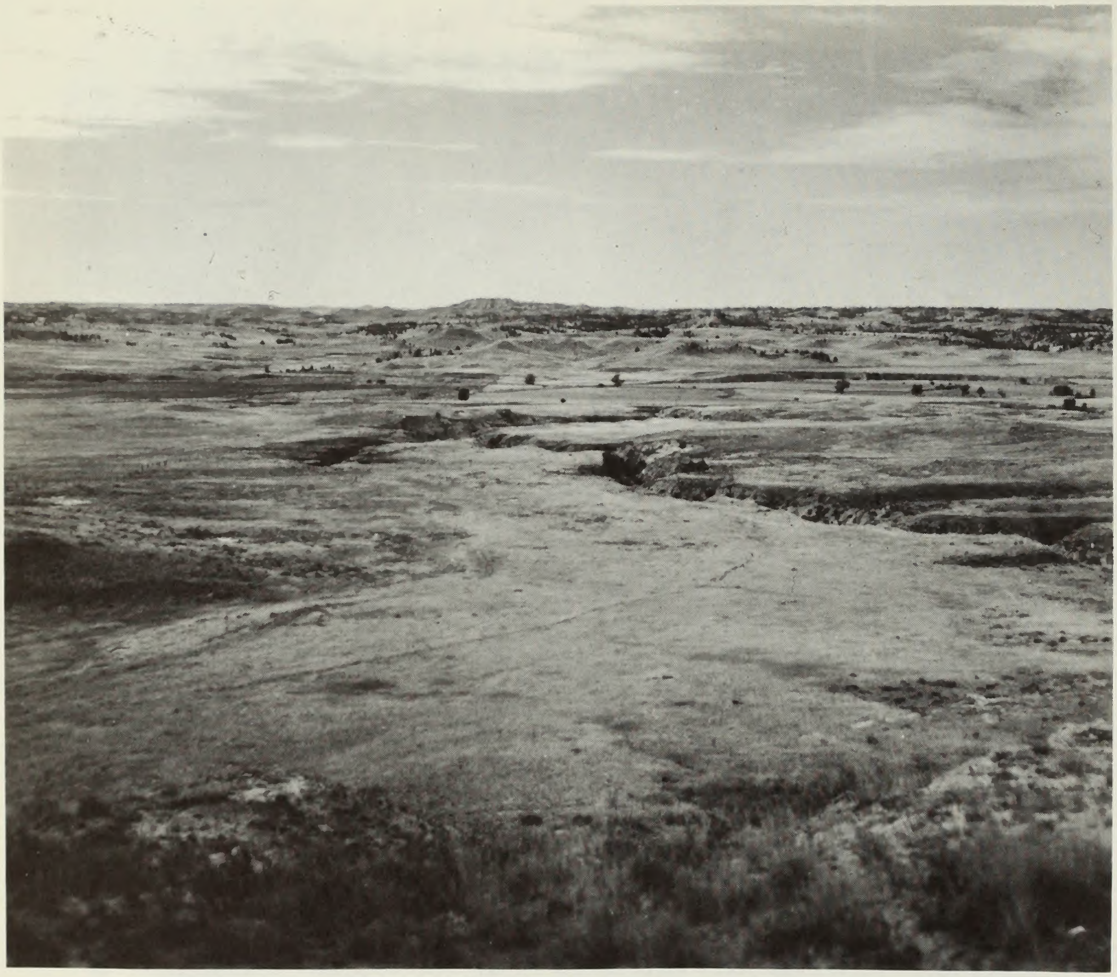


Figure 42 The bed of Rosebud Creek, shown in the distance in the above photo, is a typical tributary drainage to the Middle Yellowstone River, being incised below the general level of the valley floor. In 1857, Captain Raynolds described Rosebud Creek in part, as follows: "Its bed which, from the fact that the water is several feet below the general level in pools, are very difficult of access".

Soil loss by wind and water erosion falls into one of four classes depending on the amount of top soil removed. Class I, which denotes erosion as none to slight, is almost undetectable. Class II erosion is readily apparent; soil loss may equal three-fourths of the "A" horizon of a mature soil, or in a structureless soil, three-fourths of the top 5 inches; rills are widespread, and small gullies are common. Class III erosion represents moderate to severe soil loss; the "A" horizon is gone, representing about 5 inches of soil in the climate found in the Middle Yellowstone Area; gullies are large, deep, and impossible to cross with farm machinery. Class IV, which identifies severe erosion, was not encountered in this study of the Middle Yellowstone drainage.

Soil losses on the public domain by accelerated erosion are of relatively moderate proportions. Sixty-nine percent of the public domain was found to be in erosion Class I - none to slight; 31 percent was in Class II - slight to moderate; and only 4 acres were found in Class III - moderate to severe.

The public domain, despite its relatively steep slopes as compared to private lands, has been managed within its capabilities, with preservation of its cover of perennial grass or timber.

Field examination disclosed that 91 percent of the Land Utilization Lands (LU) were in erosion Class I, which reflects their favorable topography and the restoration that has taken place since they were removed from cultivation. The remaining 9 percent of the LU Lands were in erosion Class II. Figure 43.

Areas of severe geological erosion occasionally contribute to accelerated erosion with quick water runoff onto the public domain. Figure 44. This requires expensive and complicated control measures beyond the value of the public domain; but extending beyond the public domain in ultimate benefits.

The greatest single reason for the favorable erosion relationships on the public land is use within its land capability class.

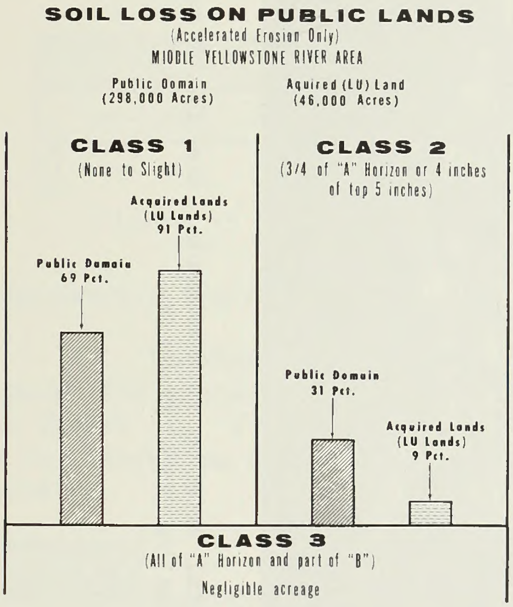


Figure 43

Despite the low rate of accelerated erosion, a problem in the Middle Yellowstone Basin is that of "frail lands". These lands are derived from parent materials with a combination of salt content, certain clays, and topography that favors erosion. Normal erosion control measures used for accelerated and geologic erosion fail on these soils - they sometimes even aggravate the problem; see appendix B on Erosion.

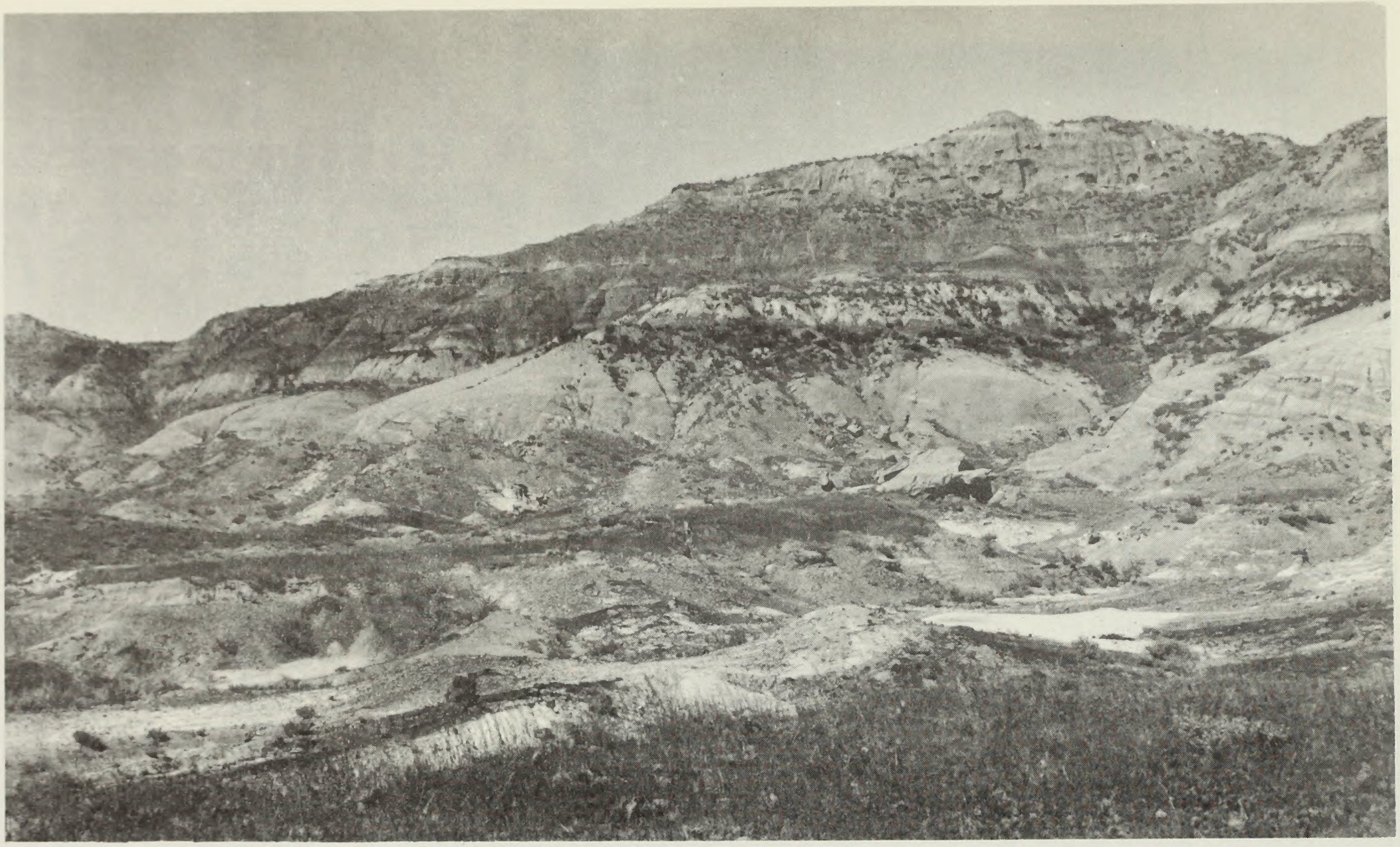


Figure 44 Badlands - geological erosion is dominant. Runoff is rapid and quickly concentrated in streams. East of Miles City, Montana.

COMPARATIVE PHOTOGRAPHIC STUDIES

The field locations of 26 photographs in the Middle Yellowstone subbasin, ranging in date from 1900 to 1930, were identified on the ground and the sites rephotographed. The resulting sets of repeat pictures were analyzed for long-term major vegetative and erosional trends. A sample for the Middle Yellowstone Area is shown in figures 49 and 50, pp. 53, 54. (The remainder are in appendix B).

The pair illustrating Forsyth, Montana, is not typical; most repeat photographs have vegetation as their principal subject; this pair emphasizes other changes pertinent to this study.

Range cover and condition, timber growth, and rate of accelerated erosion were determined for each repeat set. The three trends were then combined into a fourth, a statement of overall trend.

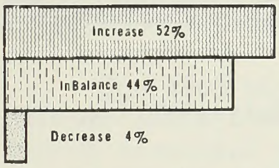


Figure 45

Timber shows a pronounced change. In addition to normal tree growth, more than half of the photographs show an increase in both tree numbers and invasions of new locations. Figure 45. A climatic change is the probable cause for the increase and invasion of trees from established stands; other subbasins of the Missouri River Basin and in Alaska and Wisconsin demonstrate the same trend.

Vegetative ground cover, trees, shrubs and grasses, has increased as shown in figure 46. This increase is reflected in a corresponding decrease in the rate of erosion.

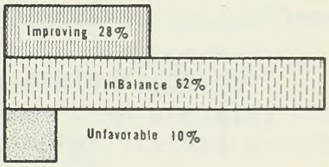


Figure 46

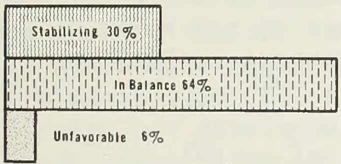


Figure 47

Gullies have stabilized and revegetated in 30 percent of the photographs; in only 6 percent is this condition growing worse. Figure 47.

"Overall" repeat photographs confirm a favorable subbasin wide situation where "improvement" and "in balance" predominate. The 26 photographic stations used in the Middle Yellowstone show an upward or improving trend on 37 percent of the sites, a favorable stable situation when environmental factors are in balance on 57 percent and an unfavorable trend on 6 percent. Figure 48.

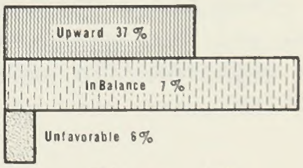


Figure 48

The stabilizing of accelerated erosion, recovery of forage plants, and the improved range condition show the effect of past deterioration of rangeland can reverse.

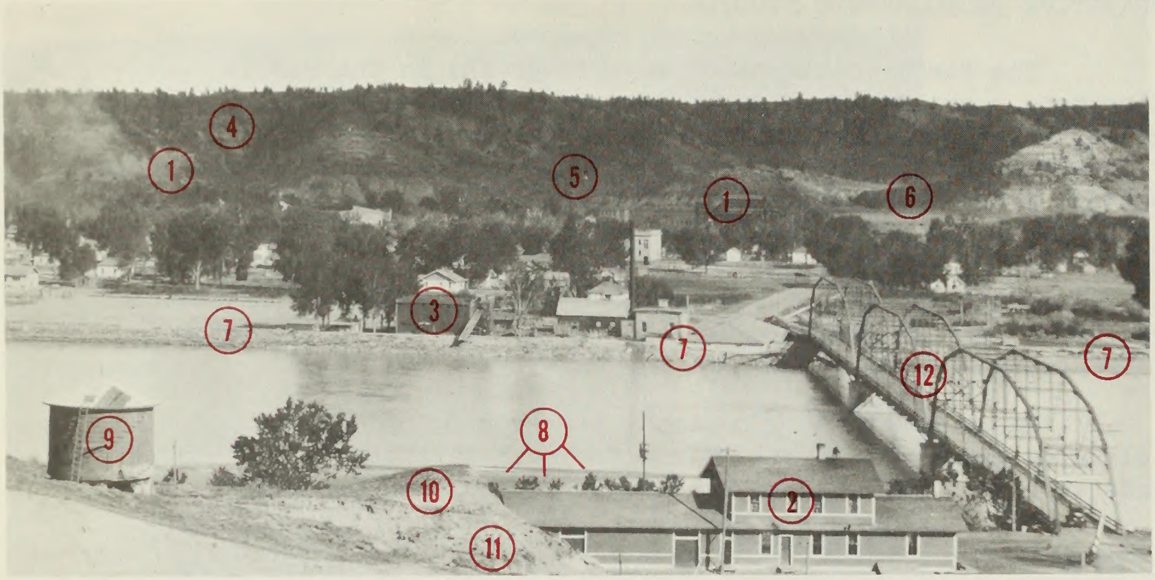


Figure 49 Collier 1920 U. S. Geological Survey Photograph

This photographic pair illustrates possibilities in repeat photographs over even short time spans. These, for example, show impact of economic and industrial development and changes in the natural environment.

Forsyth, Montana. Population 1,838. In 1920 Forsyth is an important railroad town with two railroads. It is a division point for the Northern Pacific Railway. The industrial buildings in mid-photo follow the main track ①. In the foreground are the offices and the freight and passenger depot of the Chicago, Milwaukee and St. Paul Railroad ②. On the river bank the building with a loading chute, probably for loading ice, is a vestige of commercial use of the river ③. (The Yellowstone River was dammed near Sidney, Montana in 1910, thereby cutting off commercial riverboats.)

Erosion is evident on the steep wall of the valley ④. A gully has incised deeply on the floor of the valley ⑤. The block at the valley entrance appears natural ⑥. However, the abrupt face of the drainage channel of that valley seems artificial, and the lower part of the ridge may possibly be cinders from the railroad. The banks of the river are protected by unvegetated stone rubble ⑦. A sand bar, raw and barren and at least as wide as the first pier on the bridge, extends upstream ⑧. Above the sand bar, the river is without visible obstruction.

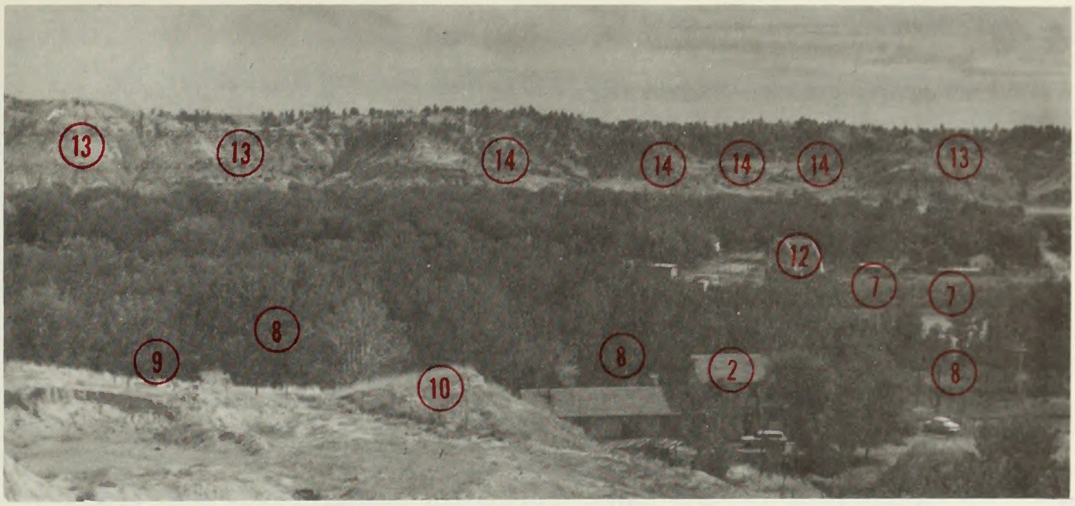


Figure 50 (1963) Forsyth, Montana

The 1963 photograph is to the rear of the original site in the 1920 photo because the gravel pit has been greatly enlarged; the camera direction is unchanged.

Population has increased by 10 percent to 2,032. In the town's economy, the railroads are still important. Oil has replaced coal for fuel and diesel engines require less servicing at points farther apart. The industrial buildings of 1920 have disappeared ①. The Chicago, Milwaukee and St. Paul Railroad expanded in 1921 to become the Chicago, Milwaukee, St. Paul and Pacific. The building at ③ is gone.

The tourist industry is growing. Increased traffic demands required a new bridge one mile upstream on the Yellowstone River. One span of the old bridge remains in place ⑫. The railroad depot ② now stands isolated from the river by the once barren sand bar; forming in 1920 ⑧, the sand bar now reaches far upstream and in 43 years has developed a dense cover of perennial grasses, trees and shrubs. The river is almost hidden in this photograph. The rubble-surfaced bank ⑦ is now covered with willows. The gravel pit in 1920 was mainly raw soil and is now revegetating with annual grasses and weeds intermixed with a few perennial grasses ⑪. The struggling perennial grass near the site of the water tank ⑨ is now vigorous ⑩. In 1920 erosion at ④ and ⑤ apparently already was stabilizing. Back of the town, ponderosa pine remains but little changed ⑬. New pine trees have established on some of the ridges and along the valley floor for a definite increase in area occupied ⑭.

The block ⑥ in the right hand valley (1920) has disappeared. The natural slopes lead to the conclusion this was artificial and has been used for fills.

CLASSIFICATION AND MULTIPLE USE ACT

By the Classification and Multiple Use Act of September 19, 1964, (PL 88-607), Congress directed the Department of the Interior, among other things, to determine which of the public domain lands were suitable for disposal and which contained values making them more suitable for retention in Federal ownership for interim management under principles stated in the Act.

The determinations called for by Congress are being made as part of the regular-fund Bureau of Land Management program, under regulations approved by the Department of the Interior. These determinations are administrative actions which appear in final form as Federal Register publications. They are basic tools for use by the Bureau of Land Management in reaching decisions on petitions for change in ownership or management of the land, including suitability for transfer to another public agency. Formal classifications under the Classification and Multiple Use Act have not yet been completed for the Middle Yellowstone Area.

Four categories have been provided under which lands may be designated in the Classification and Multiple Use procedure. Number I provides for retention where well-blocked land patterns and other considerations clearly demonstrate that long-term efficiency of administration will result. Number II is applied to areas of fragmented land pattern in which the objective is to improve management effectiveness. This may be done by consolidation of ownership, by retention of land, or by disposal. Number III is a restricted classification where management is planned for, or in cooperation with another Federal agency. Number IV designates areas where the public domain occurs as widely scattered isolated tracts or in areas near expanding communities. The majority of these tracts are regarded as subject to an orderly program of disposal, with interim management pending such action. Before any classification can be made, a Notice of Intent is published, local publicity is given, meetings of interested parties are held, and a public hearing is conducted.

RECOMMENDATIONS ON THE PUBLIC DOMAIN

In day-to-day Bureau of Land Management terminology the term "Land Classification" is used in the sense of approval for a change in ownership or management, including suitability for transfer to administration of another public agency. Classification of land within that context is made by an authorized officer of the Bureau of Land Management under authority of one of the public land laws.

In the present study the personnel have no authority to classify lands in the manner just described, although their work incorporates most of the basic data found in formal classification reports. The term "classification", and variations of the word, are thus used in this report within the limitation of classification in a technical sense, rather than classification of land in the administrative sense.

Of the 298,000 acres of public domain inventory, there are 446 individual parcels aggregating 124,000 acres, which occur as isolated tracts. By definition of the Taylor Grazing Act, an isolated tract contains no more than 1,520 acres. Larger, contiguous parcels are not regarded as being isolated.

Of the isolated tracts, 93,000 acres were considered to be best suited for retention in public ownership. The remaining isolated tracts, containing 31,000 acres were found to have characteristics which are normally indicative of transfer to private ownership. These findings are reported, tract by tract, in appendix A.

Twenty isolated tracts, comprising 4,800 acres were transferred from Federal to private ownership between the time of field examination and the writing of this report.

Individual tracts exceeding 1,520 acres in size, aggregate 169,000 acres in the Middle Yellowstone subbasin. These lands were examined by the Office of River Basin Studies but they are not described individually in appendix A. The 46,000 acres of acquired Land Utilization lands were examined in the field but they are not individually identified in appendix A.

Detailed narrative reports and maps of the isolated tracts described in appendix A are on file in the respective Bureau of Land Management District Offices at Billings and Miles City, Montana, and at the Bureau's Denver Service Center.

APPENDIX A

Summaries of Isolated Tract Inventory

Appendix A -- Description, classification of suitability, and proposed management of the public domain, by township and range, within the Isolated Tract Classification areas of the Middle Yellowstone River Area, Montana.

Introduction

The following information, in tabular form, summarizes inventory findings tract by tract. The public domain in the Middle Yellowstone River Area occurs in several land patterns. Where this pattern was one of a small acreage of public domain scattered through a predominantly private and state ownership, the land was inventoried and classed as isolated tracts. These findings, upon conclusion of the inventory, were forwarded to the appropriate District Office.

Of the 124,000 acres listed in the following tables, approximately 93,000 acres were evaluated as being best suited for retention and management in public ownership. Another 31,000 acres were considered best suited to disposal. Betweeen the time of field inventory,and publication of this report, about 4,800 acres were disposed of pursuant to Land Classification programs of the agency.

Note: The material in the tables is self-explanatory with the exception of the numbers in the columns "Present Land Use" and "Principal Suitability". The numerals which denote this land use and suitability are: 1. Grazing: 2. Cropland: 3. Recreation: 4. Wildlife: 5. Mining: 6. Watershed: 7. Timber: 8. Human Occupancy and Industrial Development: 9. Access and Preservation of Public Values: 10. Submerged. "PSW" identifies a Power Site Withdrawal; "SDW" a Stock Driveway Withdrawal; "Rec" a Recreation Site Withdrawal; and "PWR" a Public Water Withdrawal.

MONTANA PRINCIPAL MERIDIAN

Big Horn County

Twp South	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
1	38	2	Lots 7 and 8	52.50	Strong sloping rangeland	18	1-4-6	VII	1-4-6	Private
1	38	12	W½	320.00	Strongly rolling grassland	114	1-4-6	VII	1-4-6	Public
1	38	26	NE¼NE¼;E½SE¼;Lots 6,7,10,11,12	336.00	Moderate to steep grassland	48	1-4-6	VII	1-4-6	Private
1	39	6	Lots 1 and 2;NE¼SW¼	71.33	Moderate to very steep grassland	31	1-4-6	VII	1-4-6-7	Private
Rosebud County										
1	39	12	S½NW¼;N½SW¼	160.00	Strongly rolling grassland	40	1-4-6	VII	1-4-6	Private
1	40	12	Lots 1,2,3;W½NW¼;W½NE¼;NW¼SE¼	284.02	Gentle to very steep range	39	1-4-6	VII/236;VIII/48	1-4-6	Public
1	40	18	Lots 1,2,3;E½NW¼;SE¼SW¼; NE¼NE¼;SE¼SE¼	302.23	Moderate to very steep range	49	1-4-6	VII/241;VIII/61	1-3-4-6	Public
1	40	20	All	640.00	Moderate to very steep grassland	128	1-4-6	VII	1-3-4-6	Public
1	40	24	Lots 2 and 3;SW¼NE¼;SE¼NW¼	147.53	Moderate to very steep grassland	22	1-4-6	VII/93;VIII/55	1-3-4-6	Public
1	41	10	NW¼SE¼;E½SE¼	120.00	Moderate rolling grassland	25	1-4-6	VII	1-4-6	Public
1	41	18	Lots 1,2,4;E½NW¼;SE¼SW¼; NE¼NE¼;SE¼SE¼	302.23	Gentle to very steep grassland-conifer range.	49	1-4-6	VIII	1-4-6	Public
1	41	30	Lots 2,3,4;E½SW¼;SW¼SE¼;E½SE¼	302.75	Gentle to moderate rolling grassland-conifer.	53	1-4-6	VI/225;VII/78	1-4-6	Public
1	42	4	S½NW¼	80.00	Strongly rolling grassland	22	1-4-6	VII	1-4-6	Private
1	42	10	S½NE¼;NE¼NE¼;NE¼SE¼	160.00	Strongly rolling grassland	42	1-4-6	VII	1-4-6	Private
1	42	20	NE¼NW¼;N½NE½;SE¼NE¼; NE¼SE¼;S½SW¼	280.00	Gentle to strong rolling grassland	63	1-4-6	VII/184;VIII/96	1-3-4-6	Public
1	42	28	W½	320.00	Moderate rolling grassland	67	1-4-6	VII/320	1-3-4-6	Public
1	42	30	Lots 1,2,3,4;E½W½;E½	616.40	Gentle to strong rolling grassland	214	1-4-6	VII	1-3-4-6	Public
1	43	2	Lot 3	55.62	Gently rolling grassland	14	1-4-6	VI	1-4-6	Private
1	43	4	Lot 2	55.86	Moderate rolling grassland - conifer.	15	1-4-6	VI	1-4-6	Private
1	43	14	W½SW¼	80.00	Moderate rolling grassland - conifer.	18	1-4-6	VI	1-4-6	Private
1	43	22	SE¼SE¼	40.00	Gently sloping grassland	9	1	VI	1	Private
2	39	2	S½S½	160.00	Moderate to steeply rolling grassland	37	1-6	VII	1-6	Public
2	40	2	S½N½;SW¼;W½SE¼;NE¼SE¼	440.00	Moderate to very steep grassland-conifer	96	1-4-6	VII	1-4-6	Public
2	40	10	N½;N½S½	480.00	Moderate to very steep grassland-conifer.	103	1-4-6	VII	1-3-4-6	Public
2	41	4	Lots 3,4,6,7,8	201.41	Moderate rolling to rough grass-conifer breaks.	34	1-4-6	VII	1-3-4-6	Public
2	41	10	Lot 3;NE¼SW¼;N½SE¼	160.40	Moderate rolling to rough grass-conifer breaks.	55	1-4-6	VII	1-3-4-6-8	Public

Appendix A Continued

MONTANA PRINCIPAL MERIDIAN

Big Horn County

Twp South	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
6	38	24	Lot 4	9.96	Steep sloping grassland	1	1-4-6	VII	1-4-6	Private
6	38	25	Lot 1	9.83	Steep sloping grassland	1	1-4-6	VII	1-4-6	Private
7	38	25	Lots 1,2,3,4	26.08	Moderate rolling grassland	8	1-4-6	VII	1-4-6	Private
7	39	21	NW¼NW¼	40.00	Moderate rolling grassland	7	1-4-6	VII	1-4-6	Private
7	39	22	Lot 2	40.11	Moderate rolling grassland	8	1-4-6	VII	1-4-6	Private
7	39	30	Lot 1;SE¼NE¼	72.46	Moderate to strong rolling grassland.	10	1-4-6	VII	1-4-6	Private
North East										
1	38	2	Lots 3 and 4;S½NW¼;SW¼	321.16	Strong to very steep sloped grass-conifer.	123	1-4-6	VII	1-3-4-6	Public
1	38	4	Lot 1	40.07	Strongly rolling to very steep conifer	14	1-4-6	VII	1-4-6	Private
Rosebud County										
1	39	2	SW¼NE¼	40.00	Moderate to steeply rolling grass-conifer.	7	1-4-6	VII	1-4-6	Private
1	41	14	N½	320.00	Gently rolling to very steep grass-conifer.	51	1-6	VI/30;VII/129; VIII/161	1-3-4-6	Public
1	41	26	SE¼NE¼;SE¼;E½SW¼;SW¼SW¼	320.00	Moderate rolling to very steep grass-conifer	64	1-4-6	VII	1-4-6	Public
1	41	32	SW¼	160.00	Very steep grass-conifer range	24	1-4-6	VII	3-4-6	Public
1	41	34	All	640.00	Strong to steep breaks,grass, conifer.	115	1-4-6	VII	3-4-6	Public
1	42	14	SE¼NE¼;SE¼;E½SW¼;SW¼SW¼	320.00	Moderate rolling to very steep grassland.	76	1-4-6	VII	1-4-6	Public
1	42	24	NE¼NW¼;N½NE¼	120.00	Moderate rolling to very steep grassland.	23	1-4-6	VII	1-4-6	Public
1	42	30	All	641.40	Gently to moderate rolling grassland.	157	1-4-6	VI/39;VII/602	3-4-6	Public
1	43	22	NE¼NW¼;N½NE¼;S½S½	280.00	Gentle to moderate sloping grassland.	72	1-6	VI	1-6	Private
1	43	26	SE¼NE¼;SE¼;E½SW¼;SW¼SW¼	320.00	Gently sloping,grassland-conifer	90	1-6	VI	1-6	Private
1	43	34	E½	320.00	Moderate sloping grassland-conifer	84	1-6	VI	1-6	Private
Treasure County										
2	38	10	NE¼NE¼	40.00	Strong to very steep sloping grassland.	8	1-4-6	VII	1-4-6	Private

MONTANA PRINCIPAL MERIDIAN

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
Rosebud County										
2	39	12	NW¼SE¼	40.00	Moderate rolling abandoned cropland-annual grasses.	3	1	V/30;VI/10	1	Private
2	42	2	S½S½	160.00	Moderate rolling grassland range	37	1-4-6	VII	1-4-6	Private
2	42	14	All	640.00	Moderate rolling to steep grass-conifer	119	1-4-6	VII	1-4-6	Public
2	43	2	SE¼SE¼	40.00	Steep breaks grass-conifer	7	1-4-6	VII	1-4-6	Private
2	43	4	SW¼SW¼	40.00	Strongly rolling grassland	8	1-6	VII	1-6	Private
2	43	12	N½NW¼;NW¼NE¼	120.00	Steep breaks grass-conifer	21	1-4-6	VII	1-4-6	Private
Treasure County										
3	38	26	SE¼NE¼;SW¼NW¼	80.00	Moderate rolling to steep grassland.	18	1-4-6	VII	1-4-6	Private
Rosebud County										
3	39	12	Lots 1,2,3,4;W½SE¼;S½SW¼	353.96	Moderate rolling to very steep grassland.	71	1-4-6	VII	1-4-6	Public
3	40	2	All	640.60	Moderate rolling to very steep grassland.	128	1-4-6	VII	1-4-6	Public
3	40	6	SE¼NE¼;E½SE¼;Lot 7	155.85	Moderate rolling to very steep grassland.	28	1-4-6	V/20;VII/136	1-4-6	Public
3	40	8	N½N½;S½S½	320.00	Moderate rolling to rough breaks grassland.	62	1-4-6	VI/189;VII/131	1-6	Private
3	40	12	SE¼SW¼;SE¼NW¼	80.00	Gentle to steep sloping grassland	11	1-6	VII	1-6	Private
3	40	18	E½	320.00	Moderate sloping grassland to steep breaks.	67	1-4-6	VI/259;VII/61	1-4-6	Private
3	40	18	Lot 1	36.15	Gentle to moderate rolling grassland.	7	1-4	VI	1-2-9	Public
3	40	24	N½N½;S½S½	320.00	Moderate to strongly rolling grassland.	59	1-4-6	VII	1-4-6	Public
3	40	30	All	626.64	Moderate to very steep grass - conifer.	122	1-4-6	VII	1-4-6	Public
3	41	2	Lots 1 and 2;S½NE¼;SE¼	320.25	Strongly rolling grass-conifer	65	1-4-6	VII	1-4-6	Public
3	41	4	E½SE¼;SW¼SE¼	120.00	Strongly rolling grass-conifer	24	1-4-6	VII	1-3-4-6	Private
3	41	6	Lots 1 and 2;S½NE¼;SE¼	320.15	Moderate rolling to steep grassland.	39	1-4-6	VII/239;VIII/81	1-4-6	Public
3	41	10	S½SW¼	80.00	Moderate to strongly rolling grassland.	15	1-4-6	VII	1-4-6	Private
3	41	30	SE¼	160.00	Strongly rolling grassland	33	1-4-6	VII	1-3-4-6	Public
3	41	32	S½SW¼;SW¼SE¼	120.00	Moderate rolling grassland	28	1	VII	1-3	Public
3	42	6	Lot 1	44.65	Strongly rolling grassland	8	1-6	VII	1	Private

Appendix A Continued

MONTANA PRINCIPAL MERIDIAN

Rosebud County

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
3	42	12	W½	320.00	Moderate rolling to very steep grassland.	45	1-4-6	VII	1-4-6	Private
3	42	18	N½NE¼;SE¼;Lots 2 and 3	320.28	Moderate to strong sloping grass-conifer.	75	1-4-6	V/28;VII/292	1-4-6	Private
3	42	26	N½N½	160.00	Moderate rolling grassland - annuals.	31	1-4-6	VII	1-4-6	Private
3	43	20	W½W½;E½NW¼	240.00	Strongly rolling grassland	54	1-6	V/27;VII/213	1-2-6	Private
3	43	22	All	643.28	Gentle to moderate rolling grassland to steep badlands.	80	1-4-6	VII/545;VIII/98	1-4-6	Public
3	43	24	All	640.00	Strong to very steep grass - conifer breaks.	108	1-4-6	VII	1-3-4-6	Public
3	43	26	S½S½	160.00	Strong sloping grassland	32	1	VII	1	Private
3	43	30	Lot 4	43.18	Strong sloping grassland	6	1	VII	1	Private
3	44	2	W½W½	160.00	Moderate sloping grassland	31	1	VII	1	Private
3	44	6	Lots 1,3,4;NE¼NW¼;SE¼NE¼;E½SE¼	272.40	Moderate to strong sloping grassland.	15	1-4-6	VII	1-4-6	Private
3	44	30	Lots 1,2,3;E½NW¼;NE¼SW¼;NE¼;N½SE¼	485.17	Moderate to very steep grass - conifer breaks.	77	1-4-6	VII	1-3-4-6	Public
4	39	2	Lots 1,2,3,4;S½NW¼;W½SW¼	332.76	Strongly rolling to very steep grassland.	59	1-4-6	VII	1-4-6	Public
4	39	4	SE¼;SW¼NE¼;SW¼NW¼;NW¼SW¼;Lot 4	322.67	Gently rolling to very steep grassland	60	1-4-6	VI/17;VII/306	1-4-6	Public
4	39	10	N½;SE¼	480.00	Strongly rolling to very steep grassland.	86	1-4-6	VII	1-4-6	Public
4	39	14	All	640.00	Strongly rolling,rough grassland	114	1-4-6	VII	1-4-6	Public
4	40	10	All	640.00	Rolling to rough grassland breaks	85	1-4-6	VII	1-4-6	Public
4	40	12	N½;NE¼SW¼;N½SE¼;SE¼SE¼	480.00	Gentle to rough grassland	64	1-4-6	VII	1-4-6	Public
4	40	18	All	620.28	Moderate rolling to very steep grassland.	86	1-4-6	VII	1-4-6	Public
4	40	20	All	640.00	Moderate rolling to rough grassland breaks.	121	1-4-6	VII	1-4-6	Public
4	40	26	N½NE¼	80.00	Rough breaks, grassland	19	1-4-6	V/8;VII/68;VIII/4	1-4-6	Private
4	40	26	SE¼SE¼	40.00	Breaks to moderate rolling grassland.	6	1-4-6	VI/25;VII/15	1-4-6	Public
4	40	28	E½;E½W½	480.00	Moderate rolling to rough breaks grassland.	88	1-4-6	VI/183;VII/297	1-4-6	Public
4	40	32	NW¼NW¼	40.00	Moderate to strong rolling grassland.	9	1-4-6	VII	1-3-6	Public
4	40	32	SE¼SE¼	40.00	Moderate rolling to very steep grassland.	6	1-4-6	VII	1-4-6	Private

MONTANA PRINCIPAL MERIDIAN

Rosebud County

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
4	41	2	All	623.16	Rough broken grassland - breaks	58	1-4-6	VII	1-3-4-6	Public
4	41	4	Lots 3 and 4;S½NW¼;SW¼	312.64	Rolling to rough grass-conifer	56	1-4-6	VII	1-3-4-6	Public
4	41	6	All	600.11	Rough grass-conifer breaks	94	1-4-6	VII	1-3-4-6	Public
4	41	18	All	617.44	Gentle to steep rolling grassland	115	1-4-6	VII/609;VIII/8	1-3-4-6	Public
4	41	24	S½	320.00	Moderate rolling to very steep grassland.	36	1-4-6	VII	1-4-6	Public
4	41	26	All	640.00	Strongly rolling grassland	96	1-4-6	VII	1-4-6	Public
4	41	30	All	621.28	Moderate rolling to steep grassland.	87	1-4-6	VII/570;VIII/51	1-4-6	Public
4	41	32	N½	320.00	Moderate rolling to very steep grass-conifer.	57	1-4-6	VII	1-4-6	Public
4	42	8	S½	320.00	Moderate rolling to steep grassland.	60	1-4-6	VII	1-4-6	Private
4	42	12	E½NE¼	80.00	Strong rolling to very steep grassland.	16	1-4-6	VII	1-6	Private
4	42	18	Lots 3 and 4;E½SW¼;SE¼	307.64	Moderate rolling to steep grassland.	40	1-4-6	VII	1-4-6	Private
4	42	22	N½N½;S½NW¼;SE¼NE¼;SW¼SW¼	320.00	Gentle to very steep grassland	64	1-4-6	VII	1-4-6	Private
4	43	4	Lots 3 and 4;S½NW¼;S½	482.03	Moderate rolling grassland to rough breaks.	44	1-4-6	VII	1-4-6	Public
4	43	8	All	640.00	Strongly rolling to very steep grassland.	90	1-4-6	VII	1-4-6	Public
4	43	10	All	640.00	Moderate rolling to very steep grassland.	73	1-4-6	VII	1-4-6	Public
4	43	12	SW¼NW¼;N½NW¼;NW¼NE¼	160.00	Moderate rolling grassland	40	1-4-6	VII	1-4-6	Public
4	43	14	W½;NW¼SE¼;W½NE¼;NE¼NE¼	480.00	Strongly rolling grass-conifer breaks.	84	1-4-6	VII	1-3-4-6	Public
4	43	22	All	640.00	Rough grass badlands	58	1-4-6	VII	1-4-6	Public
4	43	26	N½N½	160.00	Moderate rolling grassland	31	1-4-6	VII	1-4-6	Public
4	43	28	All	653.12	Moderate rolling to rough grassland.	86	1-4-6	VII	1-4-6	Public
4	43	32	SE¼NW¼;SE¼NE¼	80.00	Moderate to strongly sloping grassland.	13	1-4-6	VII	1-4-6	Public
4	43	34	All	640.00	Rolling to rough grassland	100	1-4-6	VII	1-4-6	Public
4	44	4	Lot 2;SW¼NE¼	70.04	Moderate rolling grassland	14	1-4	VII	1-4	Public
Treasure County										
5	34	22	Lot 4	15.50	River overlook	3	1-4	VII	1-3-4-8-9	Public

MONTANA PRINCIPAL MERIDIAN

Rosebud County

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
5	38	8	SE¼SE¼	40.00	Strongly rolling sagebrush-grassland.	8	1-4-6	VII	1-4-6	Private
5	38	10	NW¼NW¼;W½SW¼;SE¼SW¼	160.00	Strongly rolling grassland	46	1-4-6	VII	1-4-6	Private
5	38	20	Lots 1,2,4	85.12	Strong to steep sloping grassland	17	1-4-6	VII	1-4-6	Private
5	39	12	E½	320.00	Strong to steep sloping grassland	60	1-4-6	VII	1-4-6	Private
5	39	22	W½NW¼	80.00	Strong rolling grassland	19	1-4-6	VII	1-4-6	Private
5	39	24	E½	320.00	Strong to very steep grassland	60	1-4-6	VII	1-4-6	Private
5	39	26	W½SW¼;SE¼SW¼	120.00	Strong to steep sloping grassland	24	1-4-6	VII	1-4-6	Public
5	39	28	S½	320.00	Strong to very steep sloping grassland.	64	1-4-6	VII	1-4-6	Public
5	39	30	Lot 1	39.40	Strongly rolling to steep grass-conifer.	7	1-4-6	VII	1-4-6	Private
5	39	34	N½N½;W½SW¼;SE¼SW¼;SW¼SE¼	320.00	Moderate rolling to steep grassland.	60	1-4-6	VII	1-4-6	Private
5	40	14	E½	320.00	Moderate rolling to very steep grassland.	58	1-4-6	VII	1-4-6	Public
5	40	24	SE¼NW¼;SW¼NE¼;W½SE¼;SW¼	320.00	Strongly rolling grassland	67	1-4-6	VII	1-4-6	Public
5	40	32	N½	320.00	Thin breaks, grass-conifer	48	1-4-6	VII	1-4-6	Private
5	40	34	S½	320.00	Rolling to very rough grassland	57	1-4-6	VII	1-4-6	Private
5	41	14	All	640.00	Moderate rolling to very steep grassland.	92	1-4-6	VI/167;VII/473	1-4-6	Public
5	41	24	N½NW¼;SE¼NW¼	120.00	Moderate to strongly sloping grass - conifer.	18	1-4-6	VII	1-4-6	Public
5	41	30	Lots 3 and 4;E½SW¼;SE¼	321.48	Strongly sloping grassland	71	1-4-6	VII	1-4-6	Public
5	41	32	W½W½;E½NW¼;N½NE¼	320.00	Moderate to steep sloping grassland.	66	1-4-6	VII	1-4-6	Public
5	42	4	Lots 1 and 2;S½NE¼;SE¼	313.12	Moderate rolling to very steep grassland.	39	1-4-6	VI/123:VII/190	1-4-6	Public
5	42	10	W½;W½E½;E½SE¼	560.00	Strong sloping thin breaks	73	1-4-6	VI/78;VII/482	1-4-6	Public
5	42	18	Lots 1 and 2;E½NW¼	159.42	Gentle to moderate rolling grassland.	32	1-4-6	VI/140;VII/19	1-4-6	Private
5	42	22	All	643.51	Moderate rolling to rough breaks grassland.	74	1-4-6	VI/65;VII/579	1-4-6	Public
5	42	24	All	627.05	Moderate rolling grassland to rough badlands.	70	1-4-6	VII	1-3-4-6	Public
5	42	30	Lot 1;NE¼NW¼;N½NE¼	159.95	Moderate to strong rolling grassland.	33	1-4-6	VII	1-4-6	Public
5	43	8	All	640.00	Moderate to strong rolling grassland.	102	1-4-6	VII	1-4-6	Public

MONTANA PRINCIPAL MERIDIAN

Rosebud County

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
5	43	12	NE¼NW¼;NE¼;N½SE¼;SE¼SE¼	320.00	Moderate rolling grassland to steep badlands.	30	1-4-6	VI/82;VII/238	1-4-6	Public
5	44	2	All	640.48	Gently rolling to steep breaks -grassland.	82	1-4-6	VI/236;VII/404	1-4-6	Public
5	44	4	Lots 1 and 2;S½NE¼;N½SE¼; SW¼NW¼;NW¼SW¼	322.62	Moderate rolling grassland to very steep badlands	38	1-4-6	VI/176;VII/147	1-4-6	Public
5	44	6	Lots 3 and 4;S½NW¼;SW¼	330.26	Moderate rolling to rough badland -grassland.	24	1-4-6	VII	1-4-6	Public
5	44	8	All	640.00	Rolling to rough badlands - grassland.	46	1-4-6	VII	1-4-6	Public
5	44	10	E½NE¼;S½SE¼;NW¼	320.00	Moderate to steep sloping grassland.	34	1-4-6	VII	1-4-6	Public
5	44	12	W½W½	160.00	Gently rolling to steep grassland	16	1-4-6	VI/102;VII/58	1-4-6	Public
5	44	12	Lots 1 and 2	96.09	Moderate to very steep badlands-grassland.	4	1-4-6	VIII	1-4-6	Private
5	44	18	N½	320.00	Moderate to steep badlands-grassland.	23	1-4-6	VII	1-4-6	Public
5	44	20	All	640.00	Moderate to steep badlands - grassland.	54	1-4-6	VII	1-4-6	Public
5	44	32	N½N½;S½NW¼;S½SE¼	320.00	Moderate to steep sloping grassland.	37	1-4-6	VI/80;VII/240	1-4-6	Public

Custer County

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
5	46	4	All	639.92	Gently sloping grassland breaks	95	1-4-6	VII	1-4-6	Public
5	46	12	E½NW¼;NE¼;E½SE¼	320.00	Moderate sloping thin breaks - grassland.	40	1-4-6	VII	1-4-6	Public
5	46	14	N½NW¼;NW¼NE¼	120.00	Gently rolling grassland	21	1-4-6	VI	1-4-6	Private

Treasure County

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
6	34	4	Lots 3 and 4	80.40	Moderate rolling grass-sagebrush range.	10	1-4-6	VII	1-4-6	Public
6	35	2	Lot 1;SE¼NE¼	78.59	Nearly level to steep grassland	15	1-4-6	VII	1-4-6	Private
6	35	6	Lot 1;SE¼NE¼;E½SE¼	159.12	Gentle to steep grassland hills	25	1-4-6	VII	1-4-6	Private
6	35	22	Lots 4 and 5	22.90	River bank and cropland	4	1-4-9-10	VII/18;VIII/5	1-3-4	Public
6	35	28	Lot 1	5.41	River bank	-	2-9	V	2-3	Private
6	35	30	Lot 6	4.59	River bottomland - cropland	-	2	V	2	Private
6	35	30	Lot 7	4.86	River bottomland	2	1-4	III	1-3-4	Public
6	36	6	Lot 1	6.58	River channel and bank	1	1-4-10	VII	3-4	Public
6	37	2	Lot 1	2.53	Strong sloping river bank	1	1-4-6	VII	1-3-4-6	Public

MONTANA PRINCIPAL MERIDIAN

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
Treasure County										
6	37	2	Lot 2	38.53	Nearly level river island	9	3-4-6	VII	3-4-6	Public
Rosebud County										
6	38	6	Lots 1 and 2	6.48	River bank	1	1-4-6	VI	1-3-4-6	Public
6	38	26	E½	320.00	Moderate rolling to steep grassland.	67	1-4-6	VII	1-4-6	Private
6	39	2	Lots 1,2,3,4;S½NE¼;SE¼NW¼	276.87	Nearly level to strongly rolling grassland.	70	1-2	V/59;VII/218	1-2-3	Public
6	39	4	Lot 4;SW¼NW¼	78.90	Gentle to strongly rolling grassland.	15	1-6	VII	1-6	Private
6	39	12	NE¼NE¼	40.00	Nearly level to very steep grassland.	8	1	VII	1-2	Private
6	39	14	Lots 2,4,6,8	39.02	Level bottom-cottonwood,shrubs	34	1	V	1-3-4	Public
6	39	18	Lot 1	13.94	Nearly level bottom-cottonwood and shrubs.	8	1-4	V	1-3	Public
6	39	20	Lot 1	.90	Level saline overflow	-	1-4	V	3-4	Public
6	40	18	Lot 3	31.84	Level island of cottonwood and shrubs.	-	1-4	V	1-3-4	Public
6	40	20	Lots 1 and 7	40.68	Level overflow grass-cottonwood	27	1-4	V	1-3-4	Public
6	40	22	Lot 1	24.15	Gently rolling grassland bench	-	1	V/10;VII/10; VIII/4	1-3	Public
6	40	24	SW¼SE¼	40.00	Moderate to strongly rolling grass-conifer.	8	1-4-6	VII	1-3-4-6	Public
6	40	34	NE¼NW¼;N½NE¼	120.00	Rolling hills-thin breaks grassland.	18	1-4-6	VII	1-3-4-6	Public
6	41	2	Lot 6	11.31	Level to gently sloping grass-cottonwoods.	7	1-4	IV	3-4	Public
6	41	12	Lot 1	.03	Swampy overflow-trees-shrubs	-	4	V	4	Private
6	42	6	Lot 8	1.67	Swampy overflow-trees-shrubs	-	4	V	4	Private
6	43	8	Lots 4 and 5	24.86	Gravel bench,level saline overflow	7	1-4	V/16;VII/9	3	Public
6	44	4	S½SE¼;NE¼SE¼	120.00	Moderate rolling to steep grassland.	19	1-4	VII	1-3	Public
6	44	10	Lot 4	26.19	Steep gravely-grassland breaks	4	1-6	VII	1-3	Public
6	44	12	Lot 1;SE¼NE¼;E½SE¼	155.50	Moderate rolling grassland	47	1-6	IV/10;VI/146	1-3-6	Public
6	44	22	S½NW¼;W½SW¼	160.00	Gently rolling to rough-annuals, perennial grasses.	8	1	VI/15;VII/145	1-3-8	Public
6	44	26	S½	320.00	Gently rolling to steep grassland	39	1-6	VI	1-4-6	Public
6	44	32	All	640.00	Moderate rolling to very steep grassland.	67	1-4-6	VI/39;VII/601	1-4-6	Public

MONTANA PRINCIPAL MERIDIAN

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
Rosebud County										
6	44	34	All	640.00	Strongly sloping to very steep badlands.	32	1-4-6	VIII	1-4-6	Public
Custer County										
6	45	10	NE¼NW¼	40.00	Strong to steeply sloping grassland.	3	1-6	VII	1-6	Private
6	45	18	E½SE¼	80.00	Gentle to moderate rolling grassland.	14	1-6	VI	1-6	Private
6	45	26	E½	320.00	Gentle to moderate rolling grassland.	51	1-4-6	VII	1-4-6	Private
6	45	30	Lots 1,3,4;E½SW¼;SE¼	412.66	Gentle to strong rolling grassland,grassland breaks.	61	1-6	VI/302;VII/111	1-4-6	Private
6	46	8	Lot 5;NE¼NW¼	56.33	Level to strongly sloping grassland.	4	1-2	V/7;VII/49	1-2	Private
6	46	18	Lots 3 and 4;E½SW¼;SE¼	304.78	Rolling grassland	49	1-4-6	VI/17;VII/288	1-4-6	Public
6	46	20	Lots 2 and 3;S½NE¼;W½;SE¼	613.34	Rough breaks and gently sloping grassland.	72	1-4-6	VI/157;VII/456	1-4-6	Public
6	46	24	Lots 5,6,7,8;S½N½;S½	549.16	Rough breaks and gently sloping grassland.	56	1-4-6	VI/331;VII/218	1-3-4-6	Public
6	46	30	E½	320.00	Gently rolling grassland to strong sloping breaks.	43	1-4-6	VII	1-4-6	Public
6	46	32	Lots 3 and 4;N½SE¼;NE¼	317.37	Low breaks and gently undulating grassland.	29	1-4-6	VII	1-4-6	Public
6	47	20	Lots 1,2,3,4;S½N½;S½	548.36	Moderate rolling to steep breaks grassland.	46	1-4-6	VII	1-4-6	Public
6	47	28	All	640.00	Badlands and breaks	40	1-4	VII/284;VIII/356	1-4	Public
6	47	30	Lots 1,2,3,4;E½W½;E½	630.28	Gently sloping grassland and rough shale breaks.	52	1-4-6	VII	1-4-6	Public
6	47	32	All	640.00	Gently sloping grassland and shale breaks.	50	1-4-6	VII	1-4-6	Public
6	47	34	All	640.00	Moderate rolling grassland	105	1-4	VII	1-4	Public
Treasure County										
7	33	2	All	640.00	Moderate sloping grassland	123	1-4-6	VII	1-4-6	Public
Yellowstone County										
7	33	18	SE¼SW¼;S½SE¼	120.00	Gently to steeply rolling grassland.	24	1-6	VI	1-6	Private

MONTANA PRINCIPAL MERIDIAN

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
Treasure County										
7	33	22	All	640.00	Moderate sloping grassland	111	1-4-6	VII	1-4-6	Public
7	33	24	All	640.00	Gentle to strong rolling grassland	117	1-4-6	VII	1-4-6	Public
7	33	26	N½N½;S½NE¼	240.00	Strongly sloping grassland range	43	1-4-6	VII	1-4-6	Public
7	33	26	SW¼SE¼;SW¼SW¼	80.00	Gentle to moderate rolling grassland	18	1-4-6	VI/40;VII/40	1-4-6	Private
Yellowstone County										
7	33	30	NE¼	160.00	Steep rolling grass-sagebrush	32	1-6	VI	1-6	Private
Treasure County										
7	33	34	NE¼;NE¼SE¼;W½SW¼;SE¼SW¼	320.00	Moderate rolling grassland range	79	1-4-6	VI/51;VII/269	1-4-6	Private
7	34	18	Lots 3 and 4;E½SW¼;SE¼	313.63	Strongly rolling to hilly	59	1-4-6	VII	1-4-6	Public
7	34	30	All	628.36	Gently rolling to hilly	90	1-4-6	VII	1-4-6	Public
7	34	32	N½NW¼;SE¼NW¼;E½SW¼	200.00	Strongly rolling to hilly	38	1-4-6	VII	1-4-6	Public
7	35	10	N½NW¼	80.00	Gently rolling grass-sagebrush	8	1-4-6	VII	1-4-6	Private
7	35	14	S½SW¼	80.00	Gently rolling grass-sagebrush	10	1-4-6	VII	1-4-6	Private
7	35	22	S½SW¼	80.00	Gently rolling grass-sagebrush	6	1-4-6	VII	1-4-6	Public
7	36	4	Lots 1 and 4;S½NW¼;SW¼	321.14	Nearly level to moderate rolling grassland.	57	1-4-6	VI	1-4-6	Public
7	36	10	N½NE¼;SE¼NE¼;NE¼SE¼	160.00	Gently rolling saline grassland	19	1-4-6	VII	1-4-6	Public
7	36	12	W½	320.00	Steeply rolling clay hills	42	1-4	VII	1-3-4	Public
7	36	26	Lot 5	23.38	River channel and bank	7	1-4	VI	1-3-4	Public
7	36	34	Lots 4 and 5	90.89	Gently rolling grassland and island.	21	1-4	VI	1-3-4	Public
7	37	2	All	640.56	Gentle to strong sloping grass-sagebrush.	56	1-4-6	VII	1-4-6	Public
7	37	6	Lots 4,5,6,7,10;SW¼NE¼;W½SE¼	317.24	Moderate rolling	35	1-3-4-6	VII	1-3-4-6	Public
7	37	12	S½	320.00	Gentle to strong sloping grass-sagebrush.	19	1-4-6	VII	1-4-6	Private
7	37	20	S½N½;N½S½	320.00	Moderate to strongly rolling grass-sagebrush.	53	1-4-6	V/34;VII/286	1-4-6	Private
7	37	24	S½	320.00	Rolling grassland range	41	1-4-6	VII	1-4-6	Public
7	37	26	NE¼NW¼;N½NE¼;SE¼NE¼	160.00	Moderate to strong rolling hills	19	1-4-6	VII	1-3-4-6	Public
Rosebud County										
7	38	10	SE¼SE¼;W½SE¼;SW¼	280.00	Moderate rolling grassland	42	1-4-6	VI/14;VII/266	1-4-6	Private

MONTANA PRINCIPAL MERIDIAN

Rosebud County

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
7	38	32	Lots 1-12;NW¼	546.80	Rolling grassland range	93	1-4-6	VII	1-3-4-6	Public
7	39	20	SE¼SW¼	40.00	Gently rolling grassland	10	1-9	V/12;VI/28	1-3-9	Public
7	40	12	N½	320.00	Rolling to steep grassland	73	1-4-6	VII	1-4-6	Public
7	41	2	S½NW¼;N½SW¼;S½S½	320.00	Moderate rolling to rough grassland.	56	1-4-6	VI/65;VII/255	1-4-6	Public
7	41	4	Lots 1 and 2;S½NE¼	159.60	Strong rolling grassland	43	1-4-6	VII	1-4-6	Private
7	41	6	Lots 6 and 7;E½SW¼;SE¼	312.36	Rolling to steep grassland	74	1-4-6	VII	1-4-6	Public
7	41	10	All	640.00	Rolling grassland range	152	1-4-6	VII	1-4-6	Public
7	41	18	Lots 1,2,3,4	145.56	Moderate rolling to steep grassland.	35	1-4-6	VII	1-4-6	Private
7	41	26	N½	320.00	Moderate rolling grassland range	90	1-4-6	VII	1-4-6	Private
7	43	4	All	626.39	Moderate rolling to steep grassland.	84	1-4-6	V/6;VII/620	1-3-6	Public
7	43	14	S½	320.00	Moderate rolling to rough grassland.	25	1-4-6	VII	1-4-6	Private
7	43	26	All	640.00	Moderate rolling to steep grassland.	71	1-4-6	VII	1-4-6	Private
7	44	12	NE¼NE¼	40.00	Gently rolling grassland	7	1-4-6	VI/25;VII/15	1-2-6	Public

Custer County

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
7	45	4	NW¼SW¼	40.00	Gently rolling grassland	9	1	VI	1-2	Private
7	45	6	All	623.21	Strong rolling grassland	130	1-4-6	VII	1-4-6	Public
7	45	14	Lot 1	24.49	Nearly level river bank and island.	1	1-4-6	VII	6	Public

Treasure County

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
8	33	22	NE¼NW¼;NW¼NE¼;S½S½;N½SE¼	320.00	Moderate to strongly sloping grassland.	71	1-6	VII	1-6	Private
8	34	20	W½SE¼;SE¼SE¼	120.00	Gently rolling grassland	24	1-6	VII	1-6	Private
8	35	22	E½	320.00	Moderate to strong rolling grassland.	37	1-6	VII	1-4-6	Public
8	35	24	All	640.00	Moderate to steep rolling grassland.	102	1-4-6	VII	1-4-6	Public
8	35	26	All	640.00	Moderate to strong sloping grass -sagebrush.	61	1-4-6	VII	1-4-6	Public
8	36	14	NE¼NW¼;NE¼;E½SE¼;SW¼SW¼	320.00	Gentle to strong sloping grassland.	33	1-4-6	VII	1-4-6	Private
8	36	18	Lots 1,2,3,4;E½W½	306.04	Gentle to strong sloping grassland.	37	1-4-6	VII	1-4-6	Public

MONTANA PRINCIPAL MERIDIAN

Treasure County

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Proposed Suitability	Principal Management
8	36	22	W½	320.00	Gently to strong sloping grassland.	40	1-4-6	VII	1-4-6	Private
8	36	26	E½	320.00	Gentle to strong rolling grassland.	51	1-4-6	VII	1-4-6	Private
8	36	28	E½	320.00	Gently rolling grass-sagebrush	48	1-4-6	VII	1-4-6	Private
8	36	30	Lots 1,2,3,4;E½SW¼;S½SE¼	302.08	Moderate rolling grassland	35	1-4-6	VII	1-4-6	Public
8	36	32	Lot 4	45.69	Gentle to strong sloping greasewood.	6	1-4-6	VII	1-4-6	Private
8	36	34	Lots 1 and 2;N½SE¼;NE¼	325.18	Gently sloping grassland	36	1-4-6	VII	1-4-6	Private
Rosebud County										
8	37	34	S½	320.00	Gentle to strong sloping sagebrush-grassland.	22	1-4-6	VII	1-4-6	Public
8	38	6	Lots 1 and 2;S½NE¼;N½SE¼;SE¼SE¼	246.08	Rolling grassland	61	1-4-6	VII	1-4-6	Public
8	38	34	N½NE¼;SE¼NE¼	120.00	Rolling to steep grassland	24	1-6	VII	1-3-6	Public
8	41	20	E½	320.00	Moderate rolling to rough grassland.	74	1-4-6	VI/45;VII/275	1-3-4-6	Public
8	41	24	SW¼SE¼	40.00	Strong rolling to hilly grassland	10	1-4-6	VII	1-4-6	Private
8	42	4	Lots 1 and 2;S½NE¼;SE¼	317.52	Moderate rolling grassland	54	1-4-6	VII	1-4-6	Private
8	42	8	NE¼NW¼;N½NE¼	120.00	Strong rolling grassland hills	25	1-4-6	VII	1-4-6	Private
8	42	12	E½NE¼;W½W½;E½SW¼	240.00	Level to steeply rolling grassland.	48	1-4-6	VI/22;VII/218	1-4-6	Public
8	42	20	All	640.00	Moderate rolling to steep grassland.	121	1-4-6	VII	1-4-6	Public
8	42	28	N½NE¼;SE¼NE¼;SW¼NW¼;S½SE¼;SW¼SW¼	280.00	Moderate to steep grassland - badland.	42	1-4-6	VII	1-4-6	Public
8	43	26	SW¼NW¼;W½SW¼	120.00	Moderate rolling to thin breaks grassland.	17	1-4-6	VII	1-4-6	Private
8	43	32	Lots 1 and 2;N½SE¼;NE¼	327.07	Gently sloping to shallow breaks	74	1-4-6	V/167;VII/160	1-2-3	Public
8	44	24	All	640.00	Undulating to hilly grassland	94	1-4-6	VII	1-4-6	Public
Custer County										
8	45	8	N½	320.00	Gentle to steep sloping grassland-badland	30	1-4-6	VI/16;VII/146; VIII/158	1-4-6	Private
8	45	18	Lots 1,2,9,10,11,12;E½NW¼	287.53	Gently sloping grassland range	44	1-4-6	VI/93;VII/195	1-4-6	Private
8	45	20	SW¼NW¼;SW¼;W½SE¼;SE¼SE¼	320.00	Gently undulating to very rough breaks.	26	1-4-6	VII/170;VIII/150	1-4-6	Public
8	45	22	N½NE¼	80.00	Gently sloping grassland	15	1-4	VI	1-4	Public

MONTANA PRINCIPAL MERIDIAN

Custer County

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
8	45	24	W½W½;E½E½	320.00	Gentle to moderate rolling grassland.	45	1-4-6	VI/17;VII/293; VIII/10	1-4-6	Public
8	45	28	W½	320.00	Gently rolling to very rough breaks.	36	1-4-6	VII/198;VIII/122	1-4-6	Public
8	45	30	All	614.08	Gently rolling to choppy breaks	101	1-4-6	VI/400;VII/214	1-4-6	Public
8	46	4	Lots 1,2,3,4;S½N½	313.16	Gentle to moderate rolling grassland and badlands.	40	1-4-6	VI/210;VIII/103	1-3-4-6	Public
8	46	6	All	576.34	Moderate to strong rolling grassland.	82	1-4-6	VI/140;VII/436	1-3-4-6	Public
8	46	8	Lots 1,2,3;NE¼NW¼	165.48	Gentle to moderate rolling grassland.	37	1-4-6	VI	1-3-4-6	Private
8	46	22	Lots 1 and 2	95.79	Moderate to steep sloping grassland.	13	1-4-6	VI/68;VII/28	1-3-6	Public
8	46	32	Lots 5,6,7,8,9,10,11;NW¼;N½SW¼	489.88	Strong sloping badlands-grassland.	52	1-4-6	VII	1-3-4-6	Public
8	48	6	Lot 4	19.37	Steeply rolling grassland	2	1-4-6	VII	1-4-6	Private
8	48	26	S½SW¼	80.00	Very steep grassland	8	1-6	VII	1-6	Private
8	50	6	Lot 7;SE¼SW¼	72.74	Gently rolling to very steep grassland range.	10	1-6	VII	1-6	Private
Rosebud County										
9	33	28	SW¼SW¼	40.00	Gently undulating grassland range.	11	1-4-6	VII	1-4-6	Private
9	35	24	N½	320.00	Gentle to moderate rolling grassland.	51	1-4-6	VII	1-4-6	Private
9	36	6	All	630.00	Moderate rolling to level grass-sagebrush.	70	1-4-6	VII	1-4-6	Public
9	36	8	N½N½;SE¼NW¼;S½NE¼;NE¼SE¼	320.00	Moderate rolling grass-saltbush-sagebrush.	36	1-4-6	VII	1-4-6	Public
9	36	10	All	640.00	Gentle to moderate rolling grass-saltbush.	62	1-4-6	VII	1-4-6	Public
9	36	20	S½NW¼;SW¼;W½SE¼	320.00	Level to gently rolling grassland	36	1-4-6	VII	1-4-6	Public
9	36	22	S½	320.00	Gentle to moderate rolling grass-sagebrush.	32	1-4-6	VII	1-4-6	Private
9	36	26	SE¼SE¼	40.00	Strongly rolling grass-sagebrush	4	1-4-6	VII	1-4-6	Private
9	38	20	N½N½;SE¼NE¼;E½SE¼;SW¼SE¼	320.00	Moderate rolling grass-saltbush-range.	53	1-4-6	VI/109;VII/211	1-4-6	Private
9	38	34	W½	320.00	Moderate rolling saltbush-grass range.	39	1-4-6	VII	1-4-6	Private
9	40	8	All	640.00	Rolling to hilly grass-sagebrush range.	114	1-4-6	VII	1-4-6	Private

MONTANA PRINCIPAL MERIDIAN

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
Rosebud County										
9	40	12	E½	320.00	Undulating to rolling grassland	57	1-4-6	VII	1-4-6	Private
9	40	20	E½SE¼;W½SW¼	160.00	Nearly level to gently rolling grassland.	27	1-4-6	VII	1-4-6	Private
9	40	34	S½SE¼;NW¼NE¼;N½NW¼;SW¼NW¼;W½SE¼	320.00	Nearly level to steep grassland	58	1-4-6	VII	1-4-6	Private
9	42	28	E½NE¼;W½W½;E½SW¼	320.00	Undulating to hilly grassland	63	1-4-6	VII	1-4-6	Private
9	44	2	All	638.72	Gently undulating to thin breaks grassland.	61	1-4-6	VII/436;VIII/203	1-4-6	Public
9	44	4	S½NE¼;SE¼;E½SW¼	320.00	Gently sloping grassland	57	1-4-6	VI	1-4-6	Private
9	44	12	All	640.00	Gently rolling to rough grassland	56	1-4-6	VII/356;VIII/284	1-4-6	Public
9	44	20	NE¼NW¼;NW¼NE¼	80.00	Gently sloping grassland	19	1-4-6	VI/38;VII/42	1-4-6	Private
9	44	24	S½	320.00	Rolling grassland range	47	1-4-6	VII	1-4-6	Private
9	44	26	SW¼SW¼	40.00	Gentle to moderate rolling grassland.	5	1-4-6	VII	1-4-6	Private
9	44	28	S½	320.00	Gently sloping grassland	44	1-4-6	VII	1-4-6	Private
9	44	34	N½N½;SE¼SE¼	200.00	Gentle to moderate rolling grassland.	8	1-4-6	VII	1-4-6	Private
Custer County										
9	45	8	All	640.00	Level to gentle sloping grassland - rough badlands.	82	1-4-6	VI/408;VIII/232	1-4-6	Public
9	45	10	W½NW¼;SE¼NW¼;SE¼SE¼	160.00	Level to gently rolling grassland	32	1-6	V/31;VI/129	1-6	Private
9	45	18	All	549.59	Gently to strongly rolling grassland.	85	1-4-6	VI/416;VII/134	1-4-6	Private
9	45	28	NW¼NE¼;E½E½;SW¼SE¼;S½SW¼	320.00	Gently to strongly sloping grassland.	46	1-4-6	VI/182;VII/138	1-4-6	Public
9	45	30	All	562.00	Gentle to moderate rolling grassland.	105	1-4-6	V/20;VI/133; VII/409	1-4-6	Public
9	45	32	N½	320.00	Gentle to strongly rolling grassland.	49	1-4-6	VII	1-4-6	Public
9	45	34	All	640.00	Gentle to moderate sloping grassland - strong to steep badlands.	84	1-4-6	VI/339;VII/301	1-4-6	Public
9	48	10	Lots 6 and 7	58.52	Rough river breaks	8	1-4-6	VII	1-3-4-6-9	Public
9	48	32	NE¼SE¼;SE¼NE¼	80.00	Strongly rolling to very steep grassland.	12	1-4-6	VII	1-4-6	Private
Rosebud County										
10	32	28	N½	320.00	Moderate rolling to steep grassland.	51	1-4-6	VII	1-3-4-6	Public

MONTANA PRINCIPAL MERIDIAN

Rosebud County

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
10	33	2	Lot 4	40.18	Gently rolling grass-sagebrush	4	1-4-6	VII	1-4-6	Private
10	33	4	Lots 1 and 2;S½NE¼;SE¼	320.58	Rolling to hilly grass-sagebrush	48	1-4-6	VII	1-4-6	Private
10	33	12	NE¼NW¼;N½NE¼	120.00	Gently rolling grass-sagebrush	19	1-4-6	VII	1-4-6	Private
10	33	18	N½NE¼	80.00	Hilly grassland range	12	1-4-6	VII	1-4-6	Private
10	34	18	Lot 4	38.26	Undulating grassland	4	1	VII	1-3	Public
10	34	28	SE¼SE¼	40.00	Level to hilly grassland	7	1-4-6	VII	1-3-4-6	Public
10	36	4	S½SE¼	80.00	Gentle to strong rolling grassland.	21	1-4-6	VI/35;VII/45	1-4-6	Private
10	36	30	Lots 3 and 4;E½SW¼;SE¼	313.51	Gentle to moderate rolling grassland.	41	1-4-6	VII	1-4-6	Public
10	36	32	W½	320.00	Moderate rolling grass-saltbush-sagebrush range.	35	1-4-6	VII	1-4-6	Public
10	37	24	S½	320.00	Moderate rolling grass-saltbush-range.	39	1-4-6	VII	1-4-6	Private
10	38	8	E½SE¼;NW¼;N½SW¼	320.00	Gentle rolling grass-saltbush range.	29	1-4-6	VII	1-4-6	Private
10	40	10	All	640.00	Level to moderate rolling grassland.	135	1-4-6	VI/247;VII/393	1-4-6	Public
10	40	22	E½	320.00	Gentle to moderate rolling grass -sagebrush range.	66	1-4-6	VI/213;VII/107	1-4-6	Private
10	40	34	E½	320.00	Gentle to moderate rolling grass -saltbush-sagebrush range.	37	1-4-6	VII	1-4-6	Private
10	43	14	S½NW¼;SW¼;W½SE¼	320.00	Gently rolling grass-saltbush range.	54	1-4-6	V/19;VI/19; VII/282	1-3-4-6	Public
10	43	28	NW¼NW¼	40.00	Gently rolling grassland	14	1-6	VI	1-2	Private
10	43	32	N½	320.00	Level to steeply rolling grass-saltbush.	32	1-4-6	VII	1-4-6	Public
10	44	2	Lots 1 and 2;SW¼NE¼	121.74	Level to gently undulating grassland.	25	1-4-6	VI/93;VII/29	1-3-6	Public
10	44	14	NE¼SE¼	40.00	Undulating to moderate rolling grassland.	9	1-4-6	VII	1-4-6	Private
10	44	20	SE¼	160.00	Gently sloping grassland range	33	1-4-6	VII	1-4-6	Private
10	44	28	S½	320.00	Moderate rolling grassland range	57	1-4-6	VII/295;VIII/25	1-4-6	Public
10	44	30	NE¼NW¼;NE¼;N½SE¼;SE¼SE¼	320.00	Gently to steeply rolling grassland.	44	1-4-6	VII/271;VIII/49	1-4-6	Public
10	44	32	N½N½;S½S½	320.00	Level to gently sloping grass-sagebrush range.	44	1-4-6	VII/272;VIII/48	1-4-6	Public
10	44	34	All	640.00	Gently rolling to steep breaks grassland.	69	1-4-6	VII/360;VIII/280	1-4-6	Public

MONTANA PRINCIPAL MERIDIAN

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
Custer County										
10	45	30	Lots 1,2,3,4;E½SW¼;S½SE¼	232.16	Level to undulating grassland to steep badlands.	32	1-4-6	V/16;VI/26; VII/190	1-3-4-6	Public
10	49	24	S½	320.00	Gently rolling to steep grassland.	45	1-4	VII	1-3-4-9	Public
10	49	34	All	640.00	Gently rolling to very steep grassland.	111	1-4	VII	1-3-4-9	Public
Rosebud County										
11	31	12	NW¼;E½SE¼;S½SW¼	320.00	Moderate to strong rolling grassland.	67	1-5	VII	1-5	Public
11	32	6	Lot 12	40.00	Moderate rolling grassland	9	1-4-6	VI	1-4-6	Private
11	32	22	E½	320.00	Moderate to strong rolling grass -sagebrush range.	67	1-5	VII	1-5	Public
11	32	28	NE¼;NW¼NW¼;W½SW¼;SE¼SW¼	320.00	Moderate to strongly rolling grass-sagebrush.	67	1-4-6	VII	1-4-6	Public
11	35	6	Lots 6 and 7;E½SW¼;SE¼	308.20	Moderate to strong rolling grass -sagebrush.	37	1-4-6	VII	1-4-6	Public
11	35	8	N½	320.00	Level to hilly grass-sagebrush range.	32	1-4-6	VII	1-4-6	Public
11	35	12	E½	320.00	Level to moderate rolling grass-greasewood range.	77	1	V/67;VI/119; VII/134	1-2	Private
11	35	14	W½	320.00	Level to strongly rolling grassland.	34	1-4-6	VII	1-4-6	Private
11	35	18	Lots 1,2,3,4;E½W½	298.68	Moderate rolling to hilly grass-sagebrush range.	33	1-4-6	VII	1-4-6	Private
11	36	4	Lots 1 and 2;S½NE¼;SE¼	319.87	Level to hilly grass-sagebrush range.	48	1-4-6	VII/235;VIII/85	1-4-6	Public
11	36	10	All	640.00	Rolling to steep grass-sagebrush range.	79	1-4-6	VII/600;VIII/40	1-4-6	Public
11	36	18	Lot 4	35.32	Gentle to moderate rolling grassland range.	10	1-4-6	VI	1-4-6	Private
11	36	26	SE¼SE¼;SW¼SW¼	80.00	Level to gently rolling grass-saltbush range.	14	1-4-6	V/8;VI/40;VII/32	1-4-6	Private
11	38	18	NE¼NE¼	40.00	Gently sloping grassland	5	1-4-6	VII	1-4-6	Private
11	38	30	Lots 1,2,3,4;E½W½	304.00	Undulating grass-saltbush range	24	1-4-6	VII	1-4-6	Private
11	38	32	W½	320.00	Gently rolling grass-saltbush range.	29	1-4-6	VII	1-4-6	Private
11	40	4	All	639.81	Gentle to moderate rolling grass - sagebrush.	103	1-4-6	VI/58;VII/582	1-4-6	Private

MONTANA PRINCIPAL MERIDIAN

Rosebud County

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
11	42	22	W½NW¼;S½SE¼;SW¼	320.00	Undulating to steep grassland	55	1-4-6	VII	1-4-6	Private
12	31	2	SW¼SW¼	40.00	Moderate to strong sloping grass-sagebrush range.	6	1-6	VII	1-6	Public
12	31	4	Lot 4	50.61	Rolling to hilly grassland-sagebrush range.	8	1-6	VII	1-6	Public
12	31	6	Lot 1;SE¼SE¼	92.83	Gentle sloping grassland-overflow meadow.	11	1	IV/3;V/3;VII/87	1-3	Public
12	31	8	NE¼;N½SE¼;SE¼SE¼	280.00	Level to gently undulating grassland.	69	1	V/32;VI/38; VII/210	1	Public
12	31	10	NE¼NE¼;SE¼SE¼;S½NW¼;SW¼	320.00	Level to hilly grassland	58	1-4	V/36;VII/284	1-4	Public
12	31	12	N½NW¼;S½SW¼;SE¼	320.00	Gently undulating to hilly grass-sagebrush range.	56	1-4	V/14;VII/306	1-4	Public
12	31	14	All	640.00	Rolling to hilly grass-sagebrush range.	111	1-4-6	VI/11;VII/629	1-4-6	Public
12	31	22	All	640.00	Gentle to strong rolling grassland range.	134	1-4-6	VI/102;VII/538	1-4-6	Public
12	31	24	N½	320.00	Strongly rolling grassland range.	57	1-4-6	VII	1-4-6	Public
12	31	34	E½;SW¼	480.00	Moderate rolling grassland range	133	1-4-6	VI	1-4-6	Public
12	32	2	Lot 4	46.79	Moderate rolling grass-sagebrush range.	11	1-4-6	VII	1-4-6	Private
12	32	4	Lot 6	40.00	Gently to moderate rolling grass-sagebrush range.	8	1-4-6	VII	1-4-6	Private
12	32	6	Lot 4	51.77	Undulating grassland	11	1-4-6	VII	1-4-6	Public
12	32	18	All	662.20	Strongly rolling grass-sagebrush range.	132	1-4-6	VII	1-4-6	Public
12	32	24	E½	320.00	Moderate to strongly rolling grass-sagebrush range.	74	1-4-6	VII	1-4-6	Public
12	33	2	Lot 4	45.84	Moderate rolling grass-sagebrush range.	9	1-4-6	VII	1-4-6	Private
12	33	4	Lot 5	40.00	Gently rolling to level grass-sagebrush range.	10	1-6	V/15;VI/25	1-6	Private
12	33	30	All	617.84	Moderate to strongly rolling grassland.	144	1-4-6	VII	1-4-6	Public
12	34	6	Lots 6,7,8, 11,12	200.00	Moderate sloping grass-sagebrush range.	36	1-4-6	VII	1-4-6	Public
12	34	6	Lot 14	10.95	Moderate sloping grass-sagebrush range.	2	1-4-6	VII	1-4-6	Private
12	34	18	Lots 1,2,3,4;E½	368.56	Gentle to strong rolling grass-sagebrush.	59	1-4-6	VII	1-4-6	Private
12	34	30	Lots 1,2,3,4	54.64	Moderate rolling grassland range.	10	1-4-6	VII	1-4-6	Private

MONTANA PRINCIPAL MERIDIAN

Rosebud County

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
12	35	8	S½	320.00	Level to undulating grass-saltbush range.	54	1-4-6	VII	1-4-6	Public
12	35	22	W½W½;SE¼NW¼;E½SW¼;SW¼SE¼	320.00	Moderate rolling to level grass-sagebrush range.	37	1-4-6	VII	1-4-6	Public
12	35	26	W½W½	160.00	Gentle to moderate rolling grassland.	24	1-4-6	VII	1-4-6	Private
12	35	28	All	640.00	Level to strongly rolling grass-sagebrush range.	120	1-4-6	VII	1-4-6	Public
12	36	4	Lots 1 and 2;S½NE¼;SE¼	314.91	Level to moderate rolling grassland.	83	1-4-6	V/78;VII/237	1-2-6	Public
12	36	6	Lots 3,4,5;SE¼NE¼	142.98	Level to gently sloping grass-saltbush.	33	1-4-6	VII	1-4-6	Private
12	36	14	W½W½	160.00	Gentle to moderate rolling grassland.	39	1-4-6	VI/112;VII/48	1-2-6	Private
12	36	18	NE¼NE¼	40.00	Moderate to strong rolling grassland	10	1-6	VII	1-6	Private
12	36	20	W½	320.00	Gentle to strong rolling grassland.	75	1-4-6	VI/67;VII/253	1-4-6	Public
12	36	30	E½	320.00	Gently to strongly rolling grassland.	65	1-4-6	VII	1-4-6	Public
12	37	6	All	600.12	Level to very steep grassland	145	1-4-6	V/62;VI/14; VII/524	1-3-4-6	Public
12	37	24	N½NE¼;SE¼NE¼;SW¼NW¼;S½SW¼; SE¼SE¼	280.00	Gentle to strong sloping grassland-grass-saltbush range.	54	1-4-6	VII	1-4-6	Public
12	38	2	S½	320.00	Gentle to moderate sloping grass-sagebrush range.	49	1-4-6	VII	1-4-6	Public
12	38	6	SE¼SE¼	40.00	Gentle to steep sloping grassland.	9	1-4-6	VII	1-4-6	Private
12	38	18	Lot 4;SE¼SW¼;NW¼NE¼;SW¼SE¼;E½E½	314.39	Gently rolling to steep grassland range.	61	1-4-6	VII	1-4-6	Public
12	38	20	All	640.00	Moderate to strong rolling grass-sagebrush range.	77	1-4-6	VII	1-4-6	Public
12	38	22	SE¼NE¼;SE¼SE¼	80.00	Gentle to moderate sloping grass-saltbush-sagebrush.	16	1-4-6	VI/40;VII/40	1-4-6	Public
12	38	28	N½	320.00	Moderate to strong rolling grass-sagebrush.	53	1-4-6	VII	1-4-6	Public
12	39	2	All	626.16	Level to moderate sloping grassland range.	112	1-4-6	VII	1-4-6	Private
12	39	4	All	622.40	Level to gently rolling grass-saltbush range.	81	1-4-6	VII	1-4-6	Public

MONTANA PRINCIPAL MERIDIAN

Rosebud County

Twp North	Range East	Sec.	Subdivision	Acres	General Land Character	AUM's	Present Land Use	Land Capability Classification	Principal Suitability	Proposed Management
12	39	6	Lots 4,5,6,7;SE¼NW¼;E½SW¼;SW¼SE¼	297.36	Gently sloping to level grassland range.	48	1-4-6	VI/51;VII/246	1-3-4-6	Public
12	39	8	N½N½;SE¼NW¼;S½NE¼;NE¼SE¼	320.00	Nearly level saltbush-grassland range.	56	1-4-6	VI/82;VII/238	1-4-6	Public
12	39	12	S½	320.00	Level to moderate rolling grass-annual range.	57	1-4-6	VII	1-4-6	Private
12	40	4	S½NE¼	80.00	Undulating to moderate rolling grassland.	19	1-4-6	VII	1-4-6	Public
12	40	20	W½W½;N½NE¼;SE¼NE¼	120.00	Gently sloping grassland	21	1-4-6	VII	1-4-6	Private
12	40	26	S½	320.00	Gently undulating grass-saltbush range.	32	1-4-6	VII	1-4-6	Private
12	40	30	NE¼NW¼;NE¼;N½SE¼;SE¼SE¼	320.00	Rolling grassland range	71	1-4-6	VII	1-4-6	Private
12	40	32	E½	320.00	Gently rolling grass-saltbush range.	52	1-4-6	VII	1-4-6	Private
12	42	30	Lots 1,2,3,4;E½W½	283.60	Gentle to moderate rolling grassland.	65	1-4-6	VII	1-3-4-6	Public
12	44	6	Lots 1 and 2	75.43	Moderate rolling grassland	26	1-6	VI	1-2	Private
13	31	32	All	640.00	Undulating to rolling grassland	99	1-6	VII	1-4-6	Public
13	35	30	Lots 1 and 2;S½NE¼;SE¼	319.40	Gentle to moderate rolling grassland.	67	1-6	VII	1-4-6	Public
13	35	32	W½	320.00	Gentle to moderate rolling grassland.	69	1-6	VII	1-4-6	Public
13	35	34	S½	320.00	Nearly level grassland	45	1-6	VII	1-4-6	Public
13	36	26	Lots 1,2,3,4;S½N½	317.76	Nearly level to moderate rolling grassland.	48	1-6	VII	1-4-6	Private
13	39	30	Lots 1 and 2	84.50	Gently sloping grassland	20	1-6	VII	1-6	Private
13	39	30	E½E½;W½SE¼	240.00	Gently sloping grassland	58	1-6	VI/55;VII/185	1-6	Public
13	39	32	S½NW¼;SW¼;S½SE¼	320.00	Gently rolling grass-sagebrush range.	54	1-6	VII	1-6	Public

APPENDIX B

Section 1	Early Journals Describing the Middle Yellowstone River Area 1805-1860
Section 2	Photographic Comparisons for Trend
Section 3	Soils
Section 4	Erosion - Piping
Section 5	Plant Frequencies
Section 6	Potential Natural Vegetation
Section 7	U. S. Geological Survey Land Classification Reconnaissance (Circa 1924)
Section 8	Annual Plants
Section 9	Wildlife - Animals and Birds
Section 10	Public Campsites

Early Journals Describing the Middle Yellowstone River Area, 1805-1860

Since 1805, explorers entering the Middle Yellowstone Area described objectively the wildlife, water quality, soil erosion, range forage and timber. Their comments on these factors along with their location at the time are shown on the accompanying sketch maps. Quotations are separated into river or overland travel classes because explorers traveling overland generally described vegetation, erosion, game, timber and topography in more detail.

Explorers leaving journals of greatest interest were Larocque in 1805, Clark in 1806, Wyeth in 1833, De Smet in 1851, Captain Raynolds in 1859 and Lieutenants Maynadier and Mullins in 1860. Larocque and Wyeth were fur traders, De Smet a missionary, and Clark, Raynolds, Mullins, and Maynadier were Army officers on official explorations.

Larocque and Raynolds rode south of the Yellowstone River. Wyeth and Clark floated the river. Maynadier rode north of the river but also had a surveying party afloat. Mullins rode along the northern watershed and De Smet traversed the area from north to south.

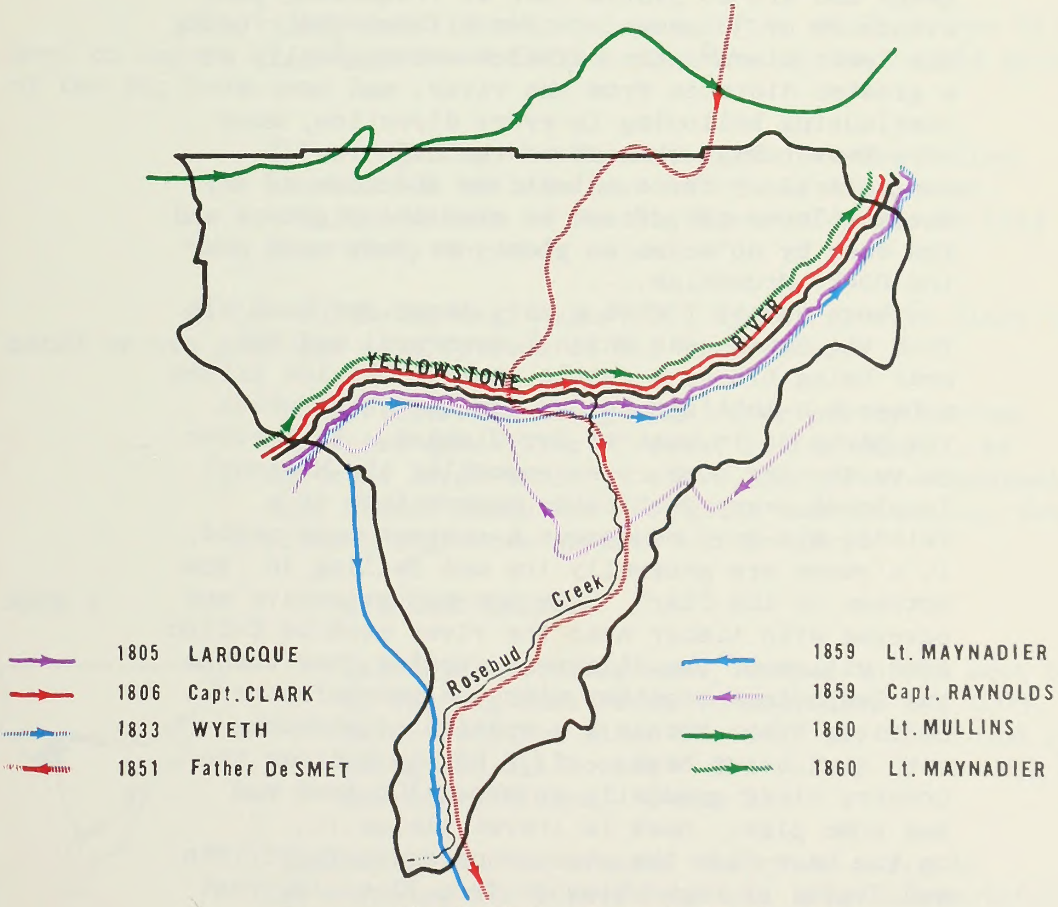


Figure 51 Routes of Early Explorers

AREA 1

RIVER TRAVEL

Clark traveling by canoe described the Big Horn River and its valley as being covered with cottonwoods under which were great quantities of rosebushes and the river as "...more mudy and of a brownish color, while that of the rochejhone [The Yellowstone] is of a lightish colour." (Area 1)

On Sunday July 27, 1806 writing of the Yellowstone:

> "...the river is much wider from 4 to 600 yards much divided by Islands and sand bars, passed a large dry Creek at [15] Miles (call Elk creek) and halted at the enterance of River 50 yards wide on the Lar^{d} Side (I call R. Labeech) killed 4 Buffalow and saved as much of their flesh as we could carry took brackfast. The Buffalow and Elk is estonishingly noumerous on the banks of the river on each side, particularly the Elk which lay on almost every point in large gangs and are so jintle that we frequently pass within 20 or 30 paces of them without their being the least alarm^{d} the buffalow are Generally at a greater distance from the river, and keep a continueing bellowing in every direction, much more beaver Sign than above the bighorn. I saw several of those animals on the bank to day. the antilopes are scerce as also the bighorns and the deer by no means so plenty as they were near the Rocky Mountains....
>
> "about sunset I shot a very large fat buck elk from the Canoe near which I encamped, and was near being bit by a rattle snake. Shields killed a Deer & a antilope to day for the skins which the party is in want of for Clothes. this river below the big horn river resembles the Missouri in almost every perticular except that it's islands are more noumerous & current more rapid, it's banks are generally low and falling in the bottoms on the Star^{d} Side low and extencive and covered with timber near the river such as Cotton wood willow of the different species rose bushes and Grapevines together with the red berry or Buffalow Grees bushes & a species of shoemake with dark brown bark. of [f] those bottoms the Country rises gradually to about 100 feet and has some pine. back is leavel plains....
> on the Lard Side the river runs under the clifts and Bluffs of high which is from 70 to 150 feet

> in hight and near the river is some scattering low pine back the plains become leave land extencive. the clifts are composed of a light gritty stone which is not very hard. and the yound stone (round stones) which is mixed with the Sand and forms bars is much smaller than they appeared from above the bighorn and may here be termed Gravel. the colour of the water is a yellowish white and less muddy than the Missouri below the mouth of this river."

Aside from the multitudes of game, other changes are apparent even though Buffaloberry "Buffalo Grees bushes", cottonwood, willow, and roses still grow in the bottoms. According to local residents, grapes were common on the bottomlands until the 1930's when severe winters and disastrous summer drouths combined to kill most of the vines. Sumac is not seen today in the bottoms. Clark's "shoemake" (sumac) may have been green ash which grows as a low scrubby tree in this area, or his sumac may have died out with the wild grapes. (Note: Elk Creek is known now as Alkali Creek and R. Labeesh as Sarpy Creek).

1833: Nathaniel Wyeth arriving at the mouth of the Big Horn on August 17, 1833 echoed Clark's comments on the turbid waters of the Big Horn.

> "17th...during the day we arrived at the Yellow Stone which was of clear water and did not mix with the waters of the Big Horn which was at this time dirty for some miles..."

On the following day, August 18, Wyeth repeated Clark's notes on big game and descriptions of the river bluffs.

> "18th...there is along this river pretty bottoms and great quantities of sweet cotton wood....We saw some large bands of elk....The river sometimes cuts bluffs which are mostly of sand stone but the river brings down granite and porphry."

AREA 2

OVERLAND TRAVEL

Larocque traveling east, camped on the west bank of the Big Horn River on September 17, 1805. He crossed the river the next day and found rough going for his horses. The valley of the Big Horn had heavy timber. (Area 2)

> "Tuesday 17th. We crossed the river early in the morning, its points here are large & beautiful

(AREA 2 CONTINUED - OVERLAND TRAVEL)

> well stocked with wood, we passed through a most abominable Country and often despaired of being able to get clear of this place enceting (sic) with Rocks which it was impossible to ascend or to go round so we were obliged often to go back on other road which presented us with the same difficulties, at last we ascended the hill but being on the top did not offer a more pleasing prospect, we were often obliged to unload the horses and carry baggage ourselves and the horses being light we made chump [jump] over chasms in the Rock and climb precipices, but were near losing them....We Kept no regular course, but went on as we could to all points of the compass in order to extricate ourselves. We Killed one Elk."

1859: Raynolds, traveling west, found the same country just as difficult. (He describes Larocque's area in the second paragraph.)

> "Thursday, September 1.-Our route this morning bore up the valley of the stream upon which we had encamped, and the travelling was detestable, although our previous experience has reconciled us to the worst roads and given confidence in our power to overcome all obstacles.
> "...from a convenient ridge [I] obtained a view of the country before us. The prospect was decidedly inauspicious, the whole surface of the adjacent hills being cut up into steep gorges, and the chances for passable roads appearing to steadily decrease."

1860: Lieutenant Maynadier the following year, rode down the Yellowstone but stayed on the north bank. Part of his crew took soundings to determine its navigability. On July 19, 1860 he entered the Middle Yellowstone Area.

AREA 3 OVERLAND TRAVEL

1859: Captain Raynolds left Fort Sarpy August 31. He comments on the complete lack of forage in the valley and the cottonwoods confined to the edge of the Yellowstone River. Earlier scouting to the west revealed no possible road for his wagons so he swung up the small valley. (Area 3)

(AREA 3 CONTINUED - OVERLAND TRAVEL)

"Wednesday, August 31.-...We pushed up the valley of the Yellowstone for nine miles over a barren, dusty plain, with scarcely the semblance of vegetation upon it, the soil resembling the dry bed of a stream, and the dust raised by the train filling the air. Turning to the left, up a small valley which looked as unpromising as any that could be imagined, we continued our journey three miles further, when we found a living spring and a tolerable supply of grass. ...we therefore encamped.

"The Yellowstone, for 10 or 15 miles above Fort Sarpy, flows entirely on the north side of the valley, having a wide plain on its right bank. The timber is confined entirely to the river's edge and is not very abundant."

AREA 4 OVERLAND TRAVEL

August 15, 1859: Captain Raynolds coming down "Emmels Creek" (now Armells Creek) had his first view at the Yellowstone River. Exciting though it was, it must have been a worry because for a long time he had suffered from a lack of grass, water, and fuel. (Area 4)

"From the summit of the hill we obtained our first view of the Yellowstone valley itself, of which over 50 square miles was visible, literally black with buffalo, grazing in an enormous herd whose numbers defy computation, but must be estimated by hundreds of thousands. We found the distance from the foot of the hills to the water about three miles, three-fourths of the intervening country consisting of a barren plain elevated about 100 feet above the water, covered doubtless at times with grass, but now cropped as closely as any village common and presenting an appearance of extreme barrenness.

Some forage was disliked by the wildlife:

"A short and abrupt descent of a few feet leads from the terrace, upon which we are encamped, to the water's edge. The bank is covered with a rich growth of weeds and salt grass, which, fortunately for us, the buffalo do not relish but our mules devour with avidity. Large cottonwood trees also border the stream, so that we can say, what we have not been able to say for a long time, wood, water, and grass are abundant."

(AREA 4 CONTINUED - RIVER TRAVEL)

July 20, 1860: Maynadier returning downstream sounding the river for navigability, found Fort Sarpy abandoned but buffalo as numerous as ever.

> "July 20.-I travelled to-day in the boat for the purpose of stopping at Fort Sarpy and sounding. The stream is here 800 or 900 yards wide, and I found no bottom with a six-foot pole. In places the current was very swift, but there were no rapids and but few snags. ...we camped about three miles below the fort. Our camp was opposite the plain on which we camped in August 1859 and now, as then, was literally alive with buffalo."

AREA 5 AND 6 OVERLAND TRAVEL

September 18, 1805: Larocque concluded the day with "fine weather plenty Elk and "Buffaloes" .... (Area 5)

RIVER TRAVEL

July 28, 1806: Clark commented on the many dry creeks. Rosebud Creek, concealed by a small island (which is no longer there), had muddy water. Coal beds were seen on the cliffs to the south. (Area 6)

> "...I arived at the enterance of a river 100 yards wide back of a small island on the South Side. it contains some Cotton wood timber and has a bold current, it's water like those of all other Streams which I have passed in the Canoes are muddy. ... The clifts on the South Side of the Rochejhone are Generally com^{d} of a yellowish Gritty soft rock, whilest those of the N. is light coloured and much harder in the evening I pass^{d} Straters of Coal in the banks on either Side those on the Star^{d} Bluffs was about 30 feet above the water and in 2 vanes from 4 to 8 feet thick, in a horozontal position. the coal contained in the Lar^{d} Bluffs is in Several vaines of different hights and thickness. this coal or carbonated wood is like that of the Missouri of an inferior quallity....
>
> "The Elk on the banks of the river were so abundant that we have not been out of sight of them to day. J Shields killed 2 deer & Labeech killed an Antilope to day. the antilopes and deer are not Abundant. Beaver plenty...."

July 19, 1833: Wyeth

> "...stopped early to try a band of Buffaloe that we see on the left of us...Nooned in a fine cool place under the shade of a large Cotton wood in a large green bottom the musquitoes take much from the pleasure of the trip...stopped on hearing the bellowing of Buffaloe on shore...killed a cow ...."

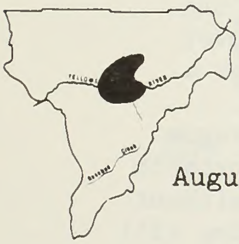
On the 20th, Wyeth's journal parallels Clark's:

> "20th...caught just a dusk last night plenty of Blue Catfish and a small one which resembles an Ale wife soon after starting this morning found an immense herd of Buffaloe close to the river stopped and killed 2 fat cows and could have killed any number more...they keep up a continuing grunting night and day now that we have fairly got into them... found bad rapids...This day and yesterday whenever the river makes perpendicular banks we saw veins of poor bituminous coal in 5 to 7 veins horizontal from 3 ft. to 6 inches thick and 10 to 15 feet above each other rock sandstone."

July 21: Maynadier passed the site of Forsyth, Montana. In camp on the 22d, the men tried to render tar for caulking the boat - a project with no success.

> "July 21.-Along the river, through a large bottom, and over several spurs which were quite rough. The hunters killed five cows near our camp and I determined to remain and dry some meat, as our provisions were running low."

AREA 7 OVERLAND TRAVEL



Cactus was common and grass poor on the plains of the Yellowstone between Armells Creek and the Rosebud in 1851. Beaver, almost trapped out in the 1830's, had recovered. (Area 7)

August 17, 1851, De Smet:

> "17th of August, at about two o'clock. We passed over a high and very level plain; for a distance of five miles the soil is light, sandy, and entirely covered with green toads, as the voyageurs call different kinds of cactus — plants that are noted for the splendor of their

(AREA 7 CONTINUED - OVERLAND TRAVEL)

> flowers and for their grotesque and varied shapes. The round and the oval, about the size of a hen's egg, found in this plain, and are set with long thorns, hard, and as fine and sharp as needles. When trampled by the horses' hoof these thorns spring up and adhere to the legs and belly of the animals, and thus render them furious and unmanageable."

Going south out of the Yellowstone Valley he wrote:

> "We soon arrived in Rosebud Valley, and continuing our route on to sunset we encamped on the borders of a little river bearing the same name, and quite near a beautiful pond, over which new dam had been constructed by the beavers.
>
> "This section of the country offered us frequent occasion of admiring the labors and ingenious industry of these intelligent animals. They are more numerous here than in any other district I have visited."

AREA 8

OVERLAND TRAVEL

Larocque, calling the Tongue River "a La Langue", and referring to cottonwoods (which were often used for horsefeed) "liards", commented: (Area 8)

> "Friday 20th. We sat this day early out, assended the hills which are rugged and barren proceeding N.E. for 36 miles. Killed one large......, fine weather with a N.E. wind.
>
> "Saturday 21st. We had a very bad road Came down to the River to see if we could find a better passage but it was impossible, the River striking the Rock at every bend and assended the hill again and with difficulty made our way over Rocks. After sun set we encamped on the River a la Langue Killed 2 Elks which were very fat.....
>
> "Sunday 22nd. We crossed the River a la Langue and passed over a plain of about 9 miles in breadth where we came again to Rocks and precipices without number over which we jogged on without stopping till 2 hours before sun set when we encamped on the side of the River close to a Rapid. There is little or no wood here along the River except a few Liards scattered here and there and no grass at all."

(AREA 8 CONTINUED - RIVER TRAVEL)

Clark in 1806, 29th July, calls the water of the Tongue River undrinkable. Captain Raynolds stated the water 20 miles upstream was clear and cold. Apparently the runoff from the badlands close to the Yellowstone had affected the water quality of the lower Tongue both then and now. Large quantities of cottonwood timber at the mouth of the Tongue were not apparent downstream.

> "...in the fore part of the day, I saw great numbers of Buffalow on the banks. the country on either side is like that of yesterday. passed three large dry Brooks on the Star^{d}. Side and four on the Lar^{d}. Side. great quantities of coal in all the hills I passed this day. late in the evening I arived at the enterance of a River which I take to be (called by Indians) the [Lazeka or Tongue River] [illegible] discharges itself on the Star^{d}. Side and is 150 yards wide of water the banks are much wider. I intended to encamp on an eligable spot imediately below this river, but finding that it's water [is] so Muddy and worm as to render it very disagreeable to drink, I crossed the rochejhone and encamped on an island close to the Lar^{d}. Shore. The water of this river is nearly milk worm very muddy and of a lightish brown colour. the current rapid and the chanel contains great numbers of snags. near its enterance there is great quantities of wood such as is common in the low bottoms of the Rochejhone and Missouri..."

> "...below this river and the Star^{d}. Side at a fiew Miles from the Rochejhone the hills are high and ruged containing Coal in great quantities. Beaver is very plenty on this part of the Rochejhone. The river widens I think it may be generally Calculated at from 500 yards to half a mile in width more Sand and gravelly bars than above. cought 3 cat fish. they wer small and fat. also a Soft Shell turtle."

July 24, 1860 - Maynadier:

> "July 24.-Passed the mouth of Tongue river and camped on an island. After receiving Tongue river, the Yellowstone becomes a little more muddy, but is not perceptibly increased in breadth or depth."

AREA 9

OVERLAND TRAVEL

September 23, 1805. Larocque rode out of the Middle Yellowstone Area: (Area 9)

> "Monday 23rd. We had a pretty level plain the whole of the day 12 miles West and 24 miles N.E. at 10 we crossed the Powder River, it has no wood on its bank here and is much shallower than when we crossed it going; its water is the same being still muddy, we encamped at night by a small Creek, having been unable to find grass for our horses throughout the day we were obliged to cut down three Lair [d]s and let the horses feed on the bark."

RIVER TRAVEL

On July 30, 1806, Clark describes Buffalo Shoals as the worst on the river. (Maynadier stated they were the most serious impediment to navigation on the Yellowstone). Clark summarizes run-off from the tributaries. His remarks could be written today.

> "...Those Dry Rivers, Creeks &c are like those of the Missouri which take their rise in and are the conveyance of the water from those plains. they have the appearance of dischargeing emence torrents of water. the late rains which has fallen in the plains raised sudenly those Brooks which receive the water of those plains on which those suden & heavy showers of rain must have fallen, Several of which I have seen dischargeing those waters, whiles those below heading or takeing their rise in the same neighbourhood, as I passed them appears to have latterly been high. those Brood[k]s discharge emencely of mud also, which contributes much to the muddiness of the river...."

Clark noted as did Larocque, the lack of trees. Clark calls the Powder River the "red stone" and agrees on its muddiness.

> "...passed the enterance of a river the water of which is 100 Yds, the bead of this river nearly $\frac{1}{4}$ of a mile this river is Shallow and the water very muddy and of the Colour of the banks a darkish brown. ...as the water was disagreeably muddy I could not camp on that Side below its mouth. however I landed at its enterance and sent out and killed two fat Cows, and took as much of the flesh as the canoes would conveniently carry and crossed the river and

(AREA 9 CONTINUED - RIVER TRAVEL)

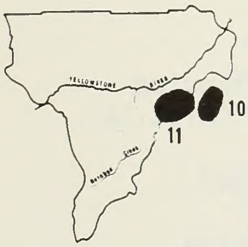
> encamped at the enterance of a Brook on the Lar^{d}. Side under a large Spredding Cotton tree. The river on which we passed to day is not so wide as above containing but fiew islands with a small quantity of Cotton timber. no timber of any kind to be seen on the high lands on either Side.
>
> "...In the evening below the enterance of redstone river I observed great numbers of Buffalow feeding on the plains, elk on the points and antilopes. I also saw some of the Bighorn Animals at a distance on the hills. Gibson is now able to walk, he walked out this evening and killed an antilope."

1833, August 21, Wyeth floated out of the Middle Yellowstone Area.

> "...passed the mouth of Powder River... the coal still continues and thousands of Buffaloe.
>
> "...the coal veins appeared thicker day fine. Buffaloe plenty."

Wyeth on the 22d of August reports that from the Rosebud, Tongue and Powder Rivers, the Yellowstone River is the same color as the Missouri but above the Big Horn is quite clear.

AREA 10 AND 11 OVERLAND TRAVEL



August 8, 1859. Captain Raynolds crossed the Tongue River about 20 miles above its mouth on the Yellowstone. At this point the river was clear and cold. Raynolds describes dense sagebrush. Surprisingly, for the first time an elk is seen. (Area 10)

> "Monday, August 8.-Our march to-day was also short and still up the valley of Tongue river...The valley here is very narrow....Twice we have been compelled to abandon it and cross spurs of hills against which it flows, but above this point the river bottom is wider and looks more inviting.
>
> "The hills we have passed are very broken, ...The road was tolerably good, the sage constituting the chief obstruction...

(AREA 10 AND 11 CONTINUED - OVERLAND TRAVEL)

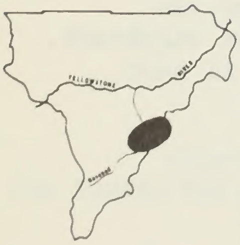
> "A magnificant buck elk was shot just after encamping, being the first of that species of game yet seen."

August 9, 1859. The party left the Tongue River on a long gradual ascent. Approaching the divide: (Area 11)

> "Near the summit we found a few stunted pines, out of which, as I was riding in advance of the train, I started an enormous grizzly bear with her cubs. After reaching the summit we travelled for some five miles over a high, undulating prairie, which drained into the Yellowstone, and from thence over rolling hills covered with pines...To the right of our course lay a range of beautifully rose-tinted hills, their summits crowned with pine and forming a marked feature in the landscape.
>
> "All the ravines in this part of our route were dry, and search was made in vain for water. We were, therefore, compelled to continue on across a ridge...We then found the country entirely changed, its surface being more level and destitute of timber.
>
> "Grass at this camp is scanty, and wood still scarcer, consisting only of small pines obtained from the sides of the distant hill. The country traversed has been worthless for agricultural purposes, and the pines are small and of no utility save for fuel."

AREA 12

OVERLAND TRAVEL



August 10, 1859: Grass was still a continuing problem; sagebrush, however was common. (Area 12)

> "Wednesday, August 10. ...I ascended a rugged butte in the vicinity, from which a view was obtained of both the Yellowstone and the Rosebud. Desolation still characterized the landscape. Naked hills were its salient features, the barrenness being only relieved by scattered pines upon rocky spurs on the left, and stunted cottonwoods and occasional strips of verdure in the river valleys.
>
> "...During the first half of the march we passed over a high, rolling plateau, destitute of grass or water, but affording an excellent road...we passed to the Rosebud itself, where we encamped upon a small spot of salt grass

(AREA 12 CONTINUED - OVERLAND TRAVEL)

> scarcely large enough for the picketing of our mules; the scarcity of pasturage still continuing in this region.
>
> "The Rosebud shows evidences of being occasionally an important stream, but now contains no running water whatever, its bed being a mere succession of stagnant pools, which from the fact that the water is several feet below the general level, are very difficult of access. The entire river bottom is covered with sage, and a scattered growth of cottonwood upon its banks completes the picture."

AREA 13

OVERLAND TRAVEL

August 11, 1859: Raynolds (Area 13)

> "Thursday, August 11.-Our route to-day lay directly over the hills to the westward.... The first three or four miles was one continued ascent, and then our course was intercepted by the head of a wide valley of the old washed lands."

Reaching the main ridge:

> "Upon each side were steep gorges filled with stunted pines, with here and there a cottonwood or cherry bush."

The train camped:

> "To my great disappointment I found the valley entirely devoid of grass and water, although filled with sage, cottonwood, and willow.
>
> "I am becoming very anxious to reach Fort Sarpy and the Yellowstone, as our mules are rapidly breaking down, and I assume that there we shall obtain better pasturage. If good grass can be found to-morrow I shall halt over Saturday and Sunday,...."

The following day the country was so rough and short of grass and water that Raynolds ordered a turn north to the Yellowstone River. August 12, 1859:

> "...Our progress in the valley was also difficult, and we went into camp at the first water reached."

(AREA 13 CONTINUED - OVERLAND TRAVEL)

He wrote of the large valley down which they traveled:

> "...I was surprised to find that the water in its bed is confined to a few pools, and is of the poorest quality. The valley is from one to two miles wide and distinguished by a considerable growth of cottonwood. Sage is abundant but the grass is rather poor."

One more day of very hard travel remained. (Raynolds' reaction on reaching the Yellowstone Valley quoted in Area 4).

AREA 14 OVERLAND TRAVEL

In August 1851 De Smet and his party went up the valley of the Rosebud River from the Yellowstone. He found, as Raynolds reported in 1859, the river to be dry and with poor water. (Maynadier reported good water in its upper reaches in 1860.) (Area 14)

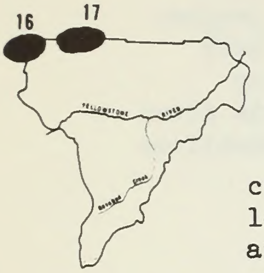
> "...For four days we continued ascending the valley of the Rosebud, about one hundred miles, as high as the sources of the river. There again we found the soil light and sandy; it was covered with wild rose-bushes, cactu and artemisia of several varieties, and intersected with ravines which were exceedingly difficult to be crossed with baggage-wagons. The shores of this river relieve the eye with an occasional group of cotton wood intermingled with plum, cherry, and service trees, which thrive here in undisturbed plenty.
>
> "The Little Wolf Mountains, whose rivulets give rise to the Rosebud River, have in general a charming appearance in their hills and acclivities- and in their combined aspect as a whole chain. The absence of water, especially of spring-water, is a painful privation to travellers in this season of the year. We found, indeed, some holes of stagnant water, in the dry beds of the rivers, but the taste is almost insupportable. The buffalo herds are less numerous here than in the lands lying further north, owing no doubt to bands of warriors that roam over the space. Yet we perceived at every moment large troops of stags and a great many deer and mountain-sheep."

1859: Lt. Maynadier synopsized his trip from September 7 to September 11 on the upper reaches of the Rosebud. Maynadier left Raynolds near the mouth of the Big Horn and went south up Tullock's Creek to the divide. Part of his notes are deleted because they deal with considerations for wagon roads: (Area 15)

> "Near its head Tullock's creek divides into three forks, and the hills change from their ridge-like precipitous character into gently sloping declivities, clothed in luxuriant grass, and dotted here and there with groves of pine trees. On the 7th September...we crossed the divide between it and the Rosebud, whose clear, running water and beautiful valley formed a delightful contrast to what we had left behind us....The valley traverses two ranges of the Wolf mountains almost at right angles,...it has a uniform width of about half a mile, and is level and free from ravines. The stream runs in a deep, narrow bed, fringed with willow and box-elder, the only timber, and would be difficult to cross with wagons....The Rosebud also divides near its head into numerous branches, some dry, some constant streams. Just before leaving it the road enters a valley so narrow, and shut in by such precipitous hills, that it may be called a cañon, and forming a view rarely equalled in picturesque grandeur. The tops of the hills are densely covered with pines alternating with bare castellated cliffs of red clay and sandstone, presenting in the combination of dark rich green and glowing scarlet a contrast of color highly pleasing. Indeed, among all my recollections of the trip, the valley of the Rosebud holds the highest place for beauty.
>
> "At the point where we left it on the 11th September the course of the stream changes abruptly to the west, while the road continuing southeast ascends a ridge, affording a view of the tributaries of Tongue river. To the north the surface of the country is one mass of barren peaks, filling the whole space between Rosebud and Tongue rivers, and forming the middle of the three ranges of the Wolf mountains."

In midsummer 1860 the Raynolds Expedition turned to the east and Lt. Mullins was given a separate party at Fort Benton to scout for a possible railroad or wagon-road route.

AREA 16 AND 17 OVERLAND TRAVEL



On July 28, 1860, Lt. Mullins crossed the Musselshell River and entered the Middle Yellowstone area: (Area 16)

> "July 28.-Left camp at 6 a.m., shaping my course east-southeast over a barren and cheerless country, which was much cut up by hills and ravines; no wood nor water, soil sandy, and containing a large proportion of lime."

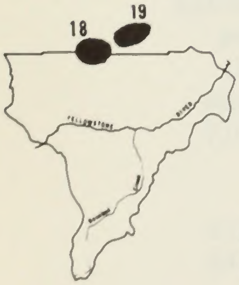
At 2 p.m. travelling over "dry and dusty" country, they reached the Musselshell:

> "...a bold, beautiful stream, about 25 or 30 yards wide, with a fine valley, which was diversified by the appearance of groves of cottonwood....The country east and south of us seems very much broken, with constant appearance of pine and cedar reefs. From this point, as far as the eye could reach, the country seemed covered with immense herds of buffalo, all moving toward the valley of the Yellowstone...The grass being tolerably good, I determined to lie here to-morrow...."

July 30, 1860, Mullins continued on: (Area 17)

> "July 30.-Continued our march...of a barren, rough country. Passed a number of herds of buffalo, who seemed to have eaten off every sprig of grass; we met with no water after leaving camp, until after a march of 23 miles we camped near the bed of a small creek containing water in holes; no grass, and but little wood. ...During the night we were much annoyed by the buffaloes running through camp."

AREA 18 AND 19 OVERLAND TRAVEL



July 31, 1860: Mullins moved to high cedar "reefs". Along the Porcupine River he saw numerous herds of buffalo and complained of the undrinkable water. (Area 18)

> "...Large herds of buffalo were visible in the different valleys. The three forks of the Porcupine were seen almost to their source, winding through white hills and cedar reefs, all coming in together near the same point and forming the main Porcupine.

(AREA 18 AND 19 CONTINUED - OVERLAND TRAVEL)

> Their green timbered valley contrasted with the white rocky bluffs and broken highlands; all the valley, being filled with buffalo, presented a striking variety in natural scenery. ...we at length reached the main river; but, to my great surprise, I found it nearly dry, there being but a few holes of water in its bed, and the water in them rendered undrinkable by the constant wallowing of the buffaloes. I therefore marched up the valley of the Porcupine four miles and encamped upon one of its tributaries, where I found better grass and purer water, although I estimated that one-third of the fluid that we dignified by the name of water was buffalo urine."

In August the party moved up to the Missouri-Yellowstone Divide. (Area 19)

> "...The whole country traversed to-day was dry and barren; no wood, water, nor grass; the latter having been entirely eaten off by the buffaloes. I now began to feel quite uneasy about my animals and feared seriously that they would not be able to make the trip; near the divide two animals broke down and I was compelled to leave them behind. Fortunately I found a camping place near some large holes of brackish water, but we had very little wood or grass. I shot a fine young cow near camp, and had barely gotten in when we were visited by a sudden and very severe hail-storm. The waters of the little creek upon which we were encamped raised suddenly so high as to overflow its valley, and force us to remove some portions of the camp to higher ground. Some of the animals were very much injured by the pelting of the large hailstones."

AREA 20 OVERLAND TRAVEL

August 7, 1851: Father De Smet, before entering the Middle Yellowstone area, commented on the numerous veins of coal in the country. (Area 20) Then:

> "...we crossed lands intersected with numerous ravines and dried streams. The soil was much lighter than that we last trod; it was covered with a species of wild artemisia, or wormwood-an infallible mark of sterility."

(AREA 20 CONTINUED - OVERLAND TRAVEL)

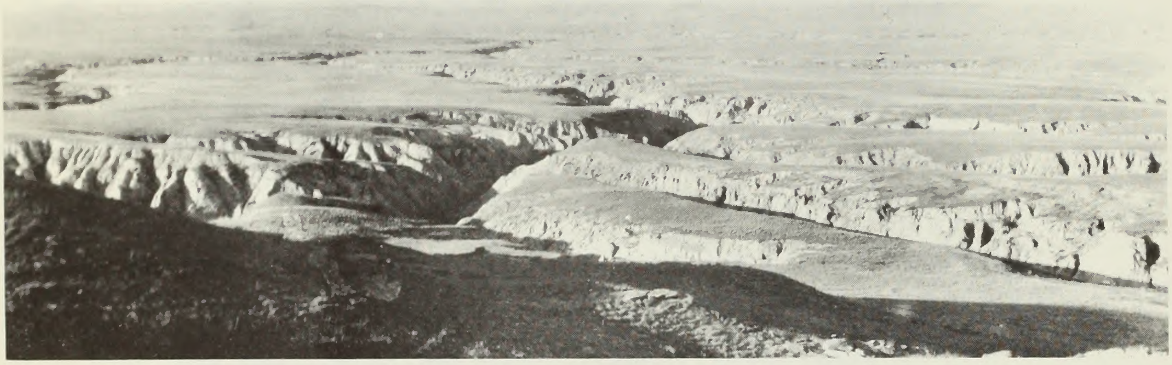


Figure 52 In 1851 the wagons of Father De Smet had hard going over these typical incised drainages of the plains north of the Yellowstone River. Further westward this cutting is not so pronounced. (U. S. Geological Survey Photograph)

Nine years later this same area traversed by Mullins was noted as dry range cut by ravines and dry creek beds. The route was chosen for defense against a large group of over 300 Crow Indians who were not friendly toward white men. Mullins' camp was on a dry creek, "water poor; grass scarce".

AREA 21 OVERLAND TRAVEL

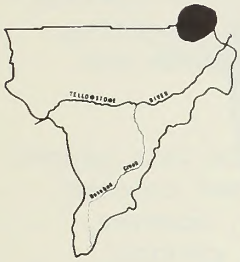
On August 5, 1860, on the broken country of the divide, Mullins was cheered by a change in the country. (Area 21)

> "August 5.-...I was gratified to observe the great change that took place in the country as we travelled eastward. The soil became better, grass more plenty and of better quality, and wood and water in the ravines....encamped at a clear, cold spring,....Plenty of cottonwood and black ash timber, and excellent grazing for the animals. ...The valley of the Yellowstone was distinctly visible, a long blue line of cottonwood timber marking its rounding course from the Big Horn mountains, while the country toward the Missouri broke off from the divide by precipitous bluffs; the drainage marked by deep ravines, all having more or less timber in them.

(AREA 21 CONTINUED - OVERLAND TRAVEL)

> "To the eastward the White Hills seemed to rise even higher than the elevation of my location, breaking off gently towards the valley of the Yellowstone in white bluffs and low round buttes. In the southwest, where the country was less broken, I noticed a large number of Indians chasing buffalo, of which many herds were in sight."

AREA 22

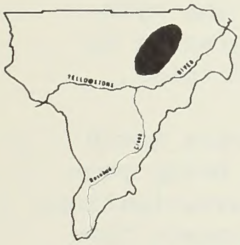


OVERLAND TRAVEL

Mullins moved only 4 miles on August 6, 1860. He had found water, fuel, and forage. (Area 22)

> "August 6.-...I encamped on a bold, running stream, containing cold, clear water; valley well timbered with black ash and cottonwood; soil along the valley excellent; grass good in quality and plenty. As the animals were considerably worn out, I determined to remain here to-day for the purpose of giving them a chance to recuperate. Shot a fine buffalo cow, which gave us ample material for a feast, to which we did justice."

AREA 23



OVERLAND TRAVEL

August 10, 1851; De Smet: (Area 23)

> "On the 10th we quitted the highlands and advanced about twenty miles, over a barren, rugged space, excavated by rains. A kind of salamander, vulgarly called "horned frog", lizards and rattlesnakes, were most abundant ...."

In summary, except for the wildlife, stability of the environment is emphasized. The conditions prevailing then and now in the Middle Yellowstone reflect the innate character of the soils and vegetation.

The over-riding comment of the explorers was the amazing and unbelievable wealth of the wildlife of the country.

The preponderance of buffalo and elk and the bighorn sheep on the plains would be expected. The smaller numbers of deer and antelope too are normal in the relatively undisturbed conditions of the plains. Now, the ratios are reversed. Deer and antelope, when protected from over-hunting, thrive under poorer range conditions and human disturbance. Their numbers are increasing.

The tree cover of the bottoms seems little changed. Again, this is expected because the alluvial soils are constantly redeposited by annual flooding; cottonwood and willow renew their cover on these fresh raw soils. Periodic flooding has occurred in both early and recent times.

Beginning with the earliest journal notes, the Yellowstone and its tributaries were always reported as muddy. The beds of the tributaries were entrenched below the level of the valleys. The Rosebud in the Middle Yellowstone Area was found to have sheer walls extending several feet below the valley level. Much of the stream sediment was a normal load representing geological erosion.

The scarcity of grass was constantly repeated. In this report area the scarcity at all seasons was sufficient to be of great concern and on occasion to cause the loss of mounts. The explorers, however, were forced to move along with probably too little time for grazing. Actually, grass on the uplands would be similar to that of today since use was light in the rugged country south of the river and wildlife numbers were few as compared with their numbers in the valley of the Yellowstone and on the plains to the north. The grass received very heavy use, almost a grubbing, where the huge herds of elk and buffalo congregated.

The "seas of grass as high as the horse's belly" was mythology, at least in this basin. Instead, sparse grass, overgrazing by wildlife, abundant cactus and heavy sagebrush were the substitutes.

The heavy stands of sagebrush found by the explorers south of the river are interesting because the grass was noted as being poor in the same valleys. Based on Missouri River Basin Group investigations elsewhere, it is concluded that this condition is far more common than once thought. The same statement would be true of cactus.

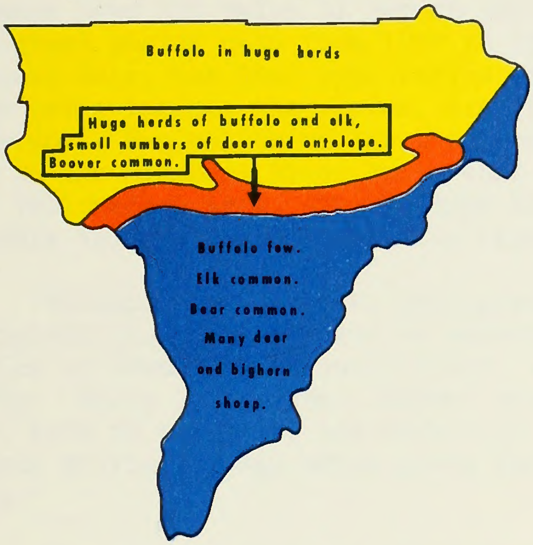
Each of the objective observations made by sincere men during earlier times now helps in establishing the limits and the potential of the country.

On the opposite page the three maps summarize in very general terms the objective observations holding true for definable areas.

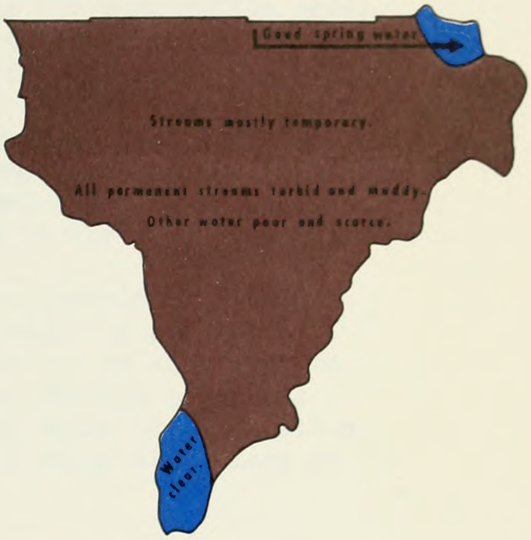
Figure 53

Summations of Most Common Journal Entries

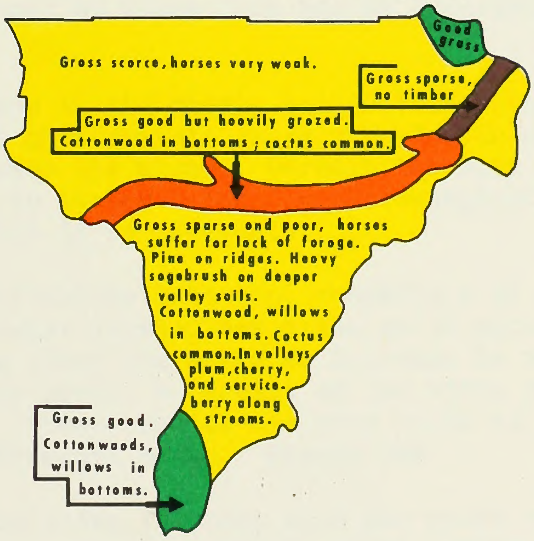
1805-1860 ——— Early Comments on Big Game



1805-1860 ——— Early Comments on Water


Good spring water
Streams mostly temporary.
All permanent streams turbid and muddy.
Other water poor and scarce.
Water clear.

1805-1860 ——— Early Comments on Vegetation


Good grass
Grass scarce, horses very weak.
Grass sparse, no timber
Grass good but heavily grazed.
Cottonwood in bottoms; cactus common.
Grass sparse and poor, horses suffer for lack of forage. Pine on ridges. Heavy sagebrush on deeper valley soils. Cottonwood, willows in bottoms. Cactus common. In valleys plum, cherry, and service-berry along streams.
Grass good. Cottonwoods, willows in bottoms.

PHOTOGRAPHIC COMPARISONS FOR TREND

Missouri River Basin and Middle Yellowstone River Area

The Missouri River Basin Field Group of the Bureau of Land Management used 168 pairs of repeat photographs for comparative study. The original photos date from 1870 to 1930; between the original and the repeat date, the time span varies from 39 to 99 years. These photographic pairs include the plains, deserts, and mountains of Wyoming and Montana. Evaluation of the photographs reveals certain general trends in the Missouri River Basin that are comparable to those in the Middle Yellowstone Area. Twenty-four of the pairs depicting sites in the Middle Yellowstone Subbasin are reproduced on the following pages.

Valuable as they are, photographs have certain limitations. The original photographic site is sometimes changed by new roads, expansion of townsites or cultivation. Grasses may be difficult to identify. Early in the year, annual growth can obscure perennial plants; late in the year, the effect of grazing makes identification of plants difficult, and often gives the site a false appearance of overuse.

The rate of erosion, establishment of shrubs, and identity of trees can easily be seen; the trend of vegetation may be easy to evaluate for one species and difficult for another because the foreground and background vary by seasons. Photographs find their best use for providing general conclusions; at times they can be surprisingly specific.

Comparison of trends in the Middle Yellowstone Subbasin with the Missouri River Basin by photographic pairs reveals the close association of percentages between the areas. Perhaps the most surprising fact is the great increase in timber. The low percentage of unfavorable trends in all categories is of interest.

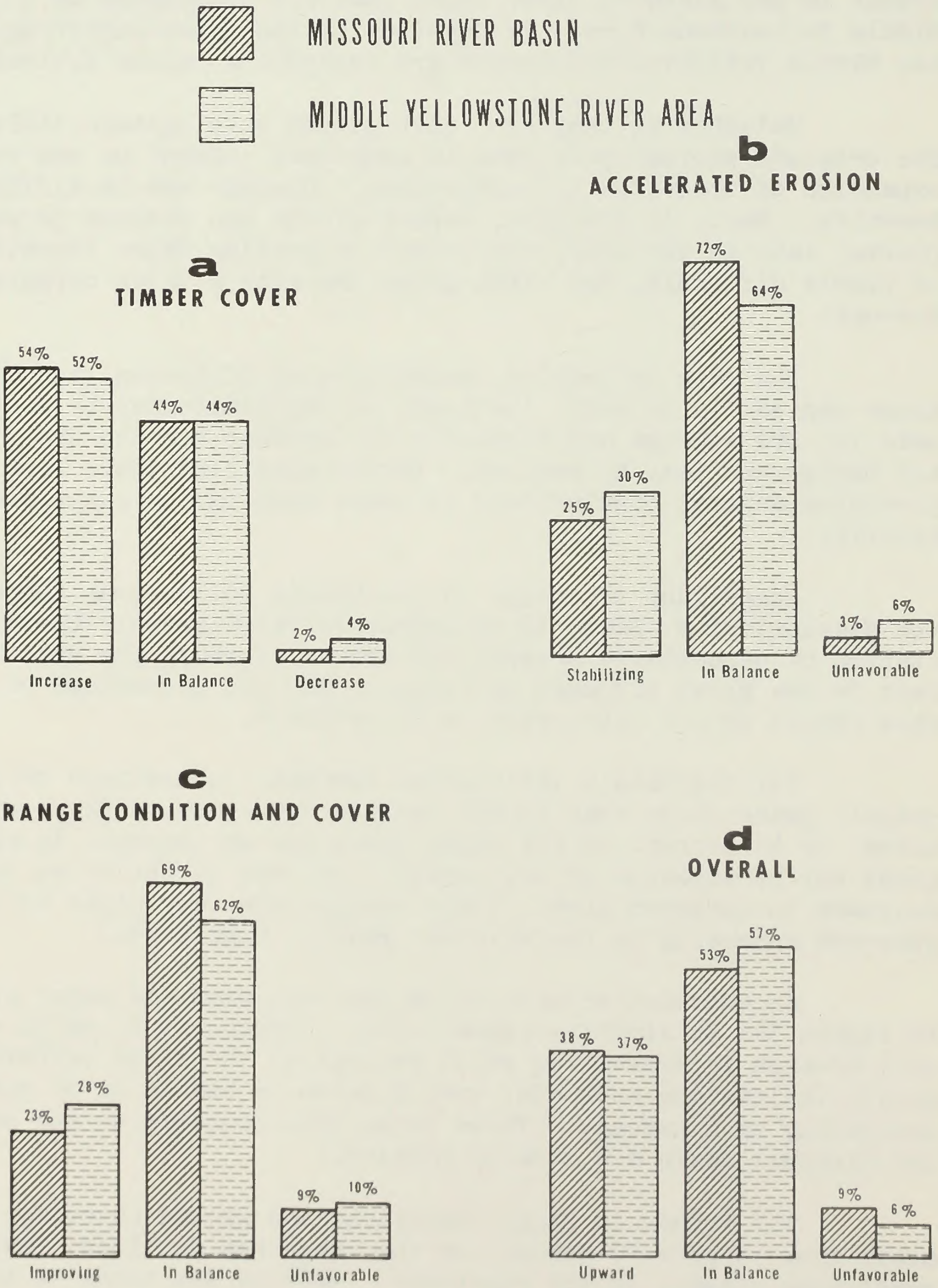
For the Middle Yellowstone Subbasin, comparison of photographic pairs shows that timber invaded new areas on 52 percent of the sites; on 44 percent of the sites there was an increase in size of trees but no invasion of new areas; 4 percent of the sites showed a decrease in timbered area. These results are very close to conditions observed generally in the Missouri Basin. Figure 54a.

Accelerated erosion rates for both wind and water are combined in figure 54b to simplify presentation. Photographic pairs show that soil erosion is decreasing on 30 percent of the sites reviewed in the Middle Yellowstone subbasin; soil erosion is stable on 64 percent and increasing on 6 percent. These rates when compared to the rates of the Missouri Basin are closely parallel.

The trends in range conditions and ground cover for the two areas show roughly 10 percent of the range has declined; favorable conditions prevail on the remainder. Most of the range is in balance with its environment and well over one-fourth is improving. Figure 54c.

Figure 54

TRENDS
(revealed by repeat photography)
for
MISSOURI RIVER BASIN
MIDDLE YELLOWSTONE RIVER AREA



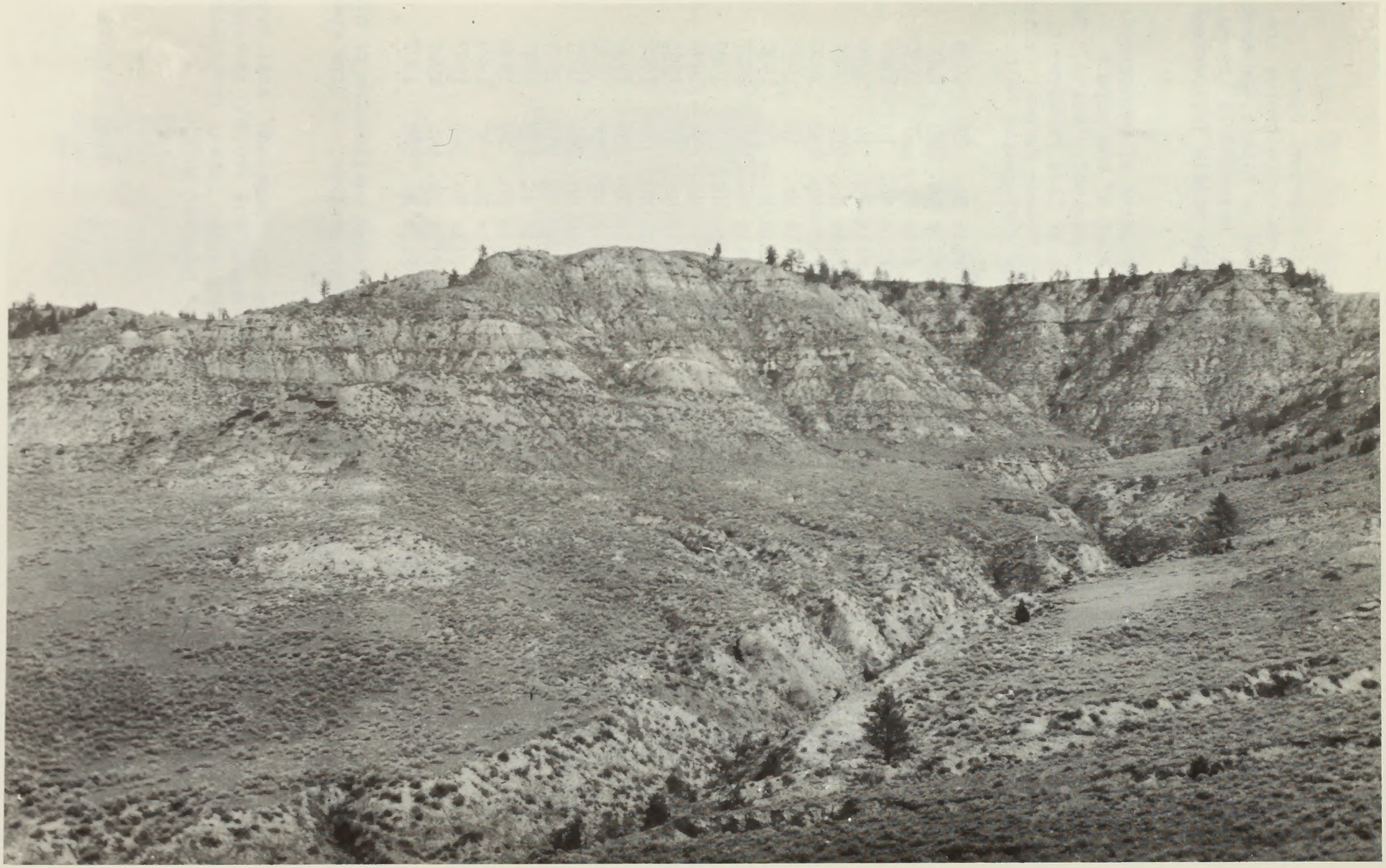
The "Overall" trend in a comparison of Missouri River Basin photographs with the Middle Yellowstone Area demonstrates the similarity between the two areas. "Upward" trend is almost the same; "In Balance" conditions predominate in both; in "Unfavorable" trend, which is less than 10 percent in either area, the Middle Yellowstone has a more favorable ratio. Figure 54d.

The advantages and problems of repeat pairs of photographs are illustrated in the 24 pairs that follow. Most of the repeat photographs are at or within a few feet of the original station. Repeat photographs, by R. D. Burr, are filed at Bureau of Land Management, Office of Basin Studies, Denver Service Center, Denver Federal Center, 80225. These match the U. S. Geological Survey photographs below:

Figure 55	upper	Dobbin	USGS File No. 20	1930
Figure 56	upper	Stanton	USGS File No. 829	1900
Figure 57	upper	Pierce	USGS File No. 27	1930
Figure 58	upper	Baker	USGS File No. 70	1924
Figure 59	upper	Dobbin	USGS File No. 14	1930
Figure 60	upper	Collier*	USGS File No. 512	1907
Figure 61	upper	Stanton	USGS File No. 832	1900
Figure 62	upper	Dobbin	USGS File No. 18	1930
Figure 63	upper	Dobbin	USGS File No. 24	1930
Figure 64	upper	Collier*	USGS File No. 544	1907
Figure 65	upper	Lupton	USGS File No. 74	1909
Figure 66	upper	Dobbin	USGS File No. 34	1930
Figure 67	upper	Dobbin	USGS File No. 28	1930
Figure 68	upper	Lupton	USGS File No. 75	1909
Figure 69	upper	Dobbin	USGS File No. 30	1930
Figure 70	upper	Stanton	USGS File No. 831	1900
Figure 71	upper	Collier*	USGS File No. 525	1907
Figure 72	upper	Collier*	USGS File No. 527	1907
Figure 73	upper	Collier*	USGS File No. 526	1907
Figure 74	upper	Dobbin	USGS File No. 29	1930
Figure 75	upper	Baker	USGS File No. 38	1924
Figure 76	upper	Collier*	USGS File No. 545	1907
Figure 77	upper	Collier*	USGS File No. 546	1907
Figure 78	upper	Collier*	USGS File No. 503	1907

*Note: 1907 on Collier photographs is the date of publication of his report; actual photography is four to six years earlier. A time span of 55 years based on 1907 is probably 60 years.

The early photographs sampling timber, rangeland, soil erosion and economic developments were chosen from among the 140,000 photographs of the Department of the Interior, U. S. Geological Survey Photo Library, Building 25, Denver Federal Center, Denver, Colorado 80225.



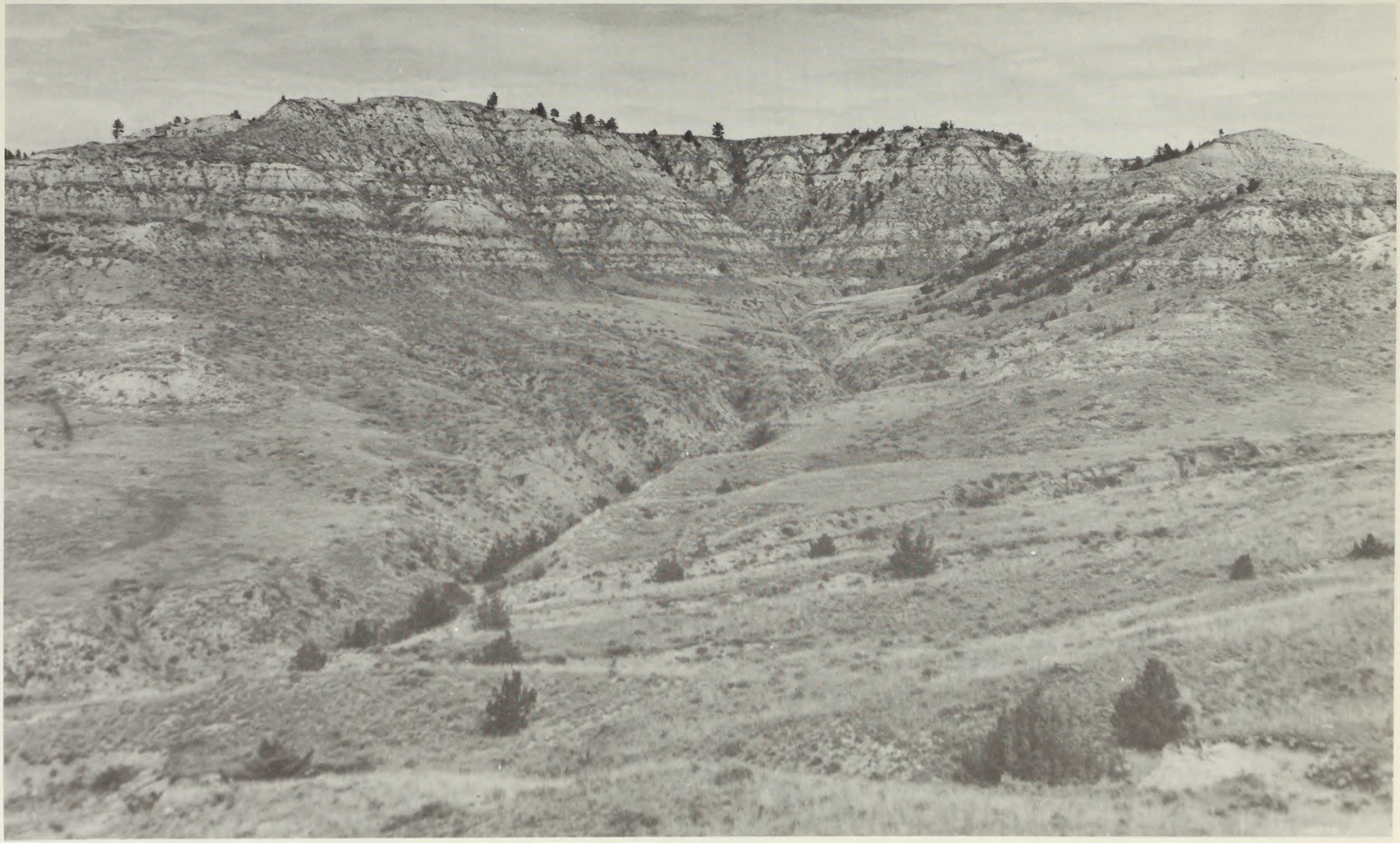
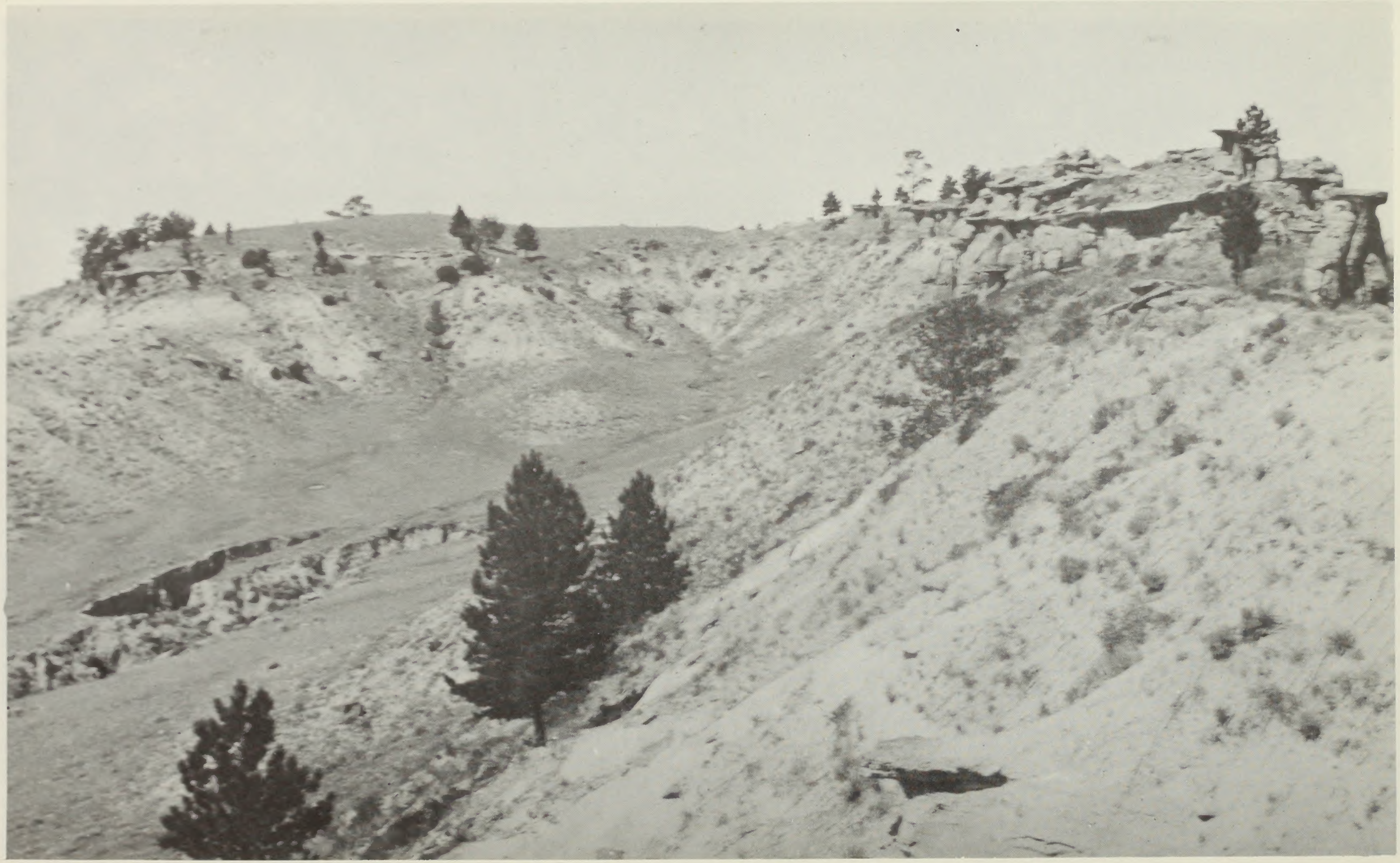


Figure 55   Top photo Dobbin, 1930. Bottom photo BLM, 1963. Time span 33 years. Marked reduction of sagebrush and equally definite increase of grasses. Range condition is improving. Erosion rate is normal, gullies apparently stabilized. Increase in juniper improves deer feed and cover. The mature trees on the ridge have all disappeared. The area is naturally restocking beyond the amount of timber shown in 1930.



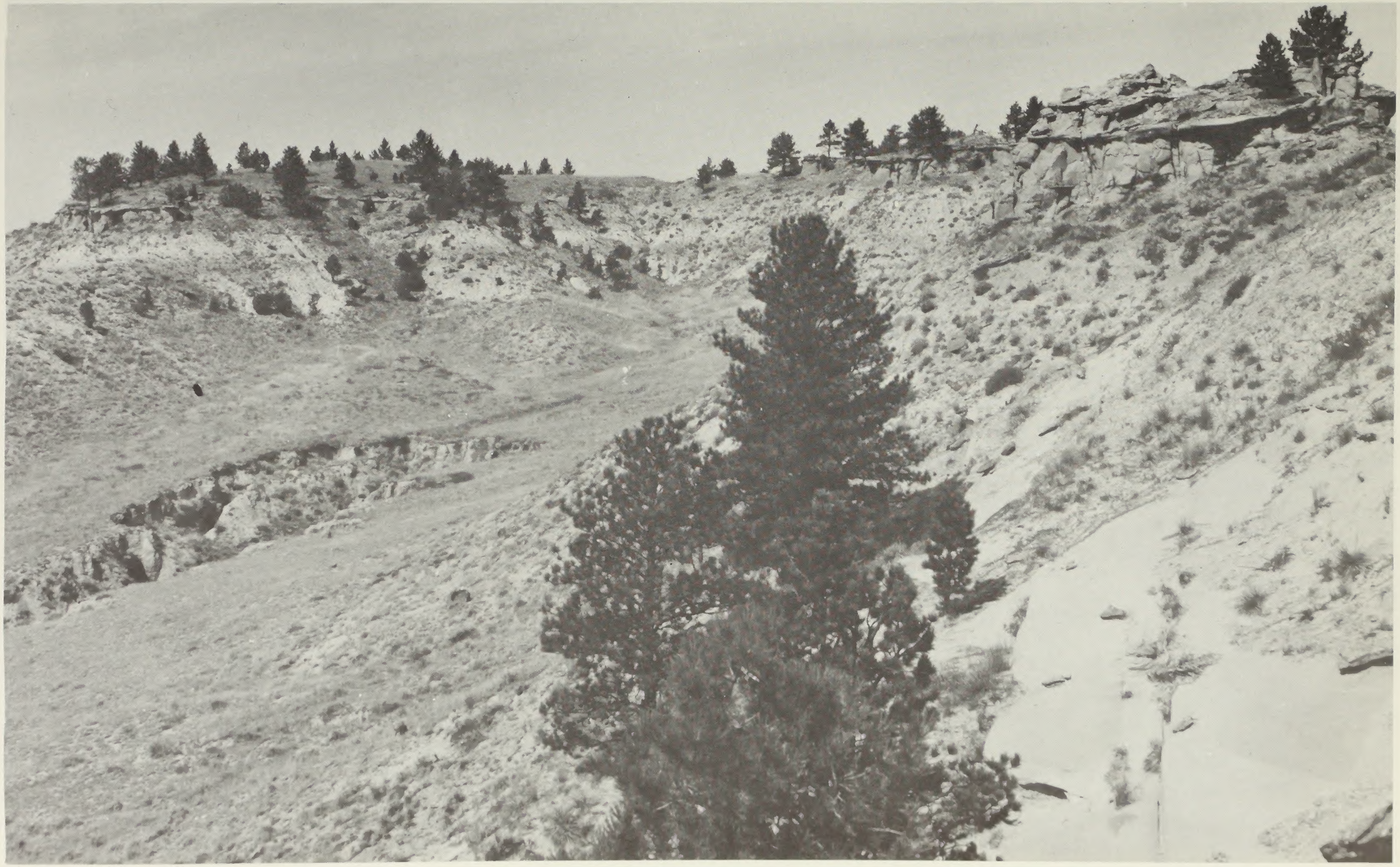
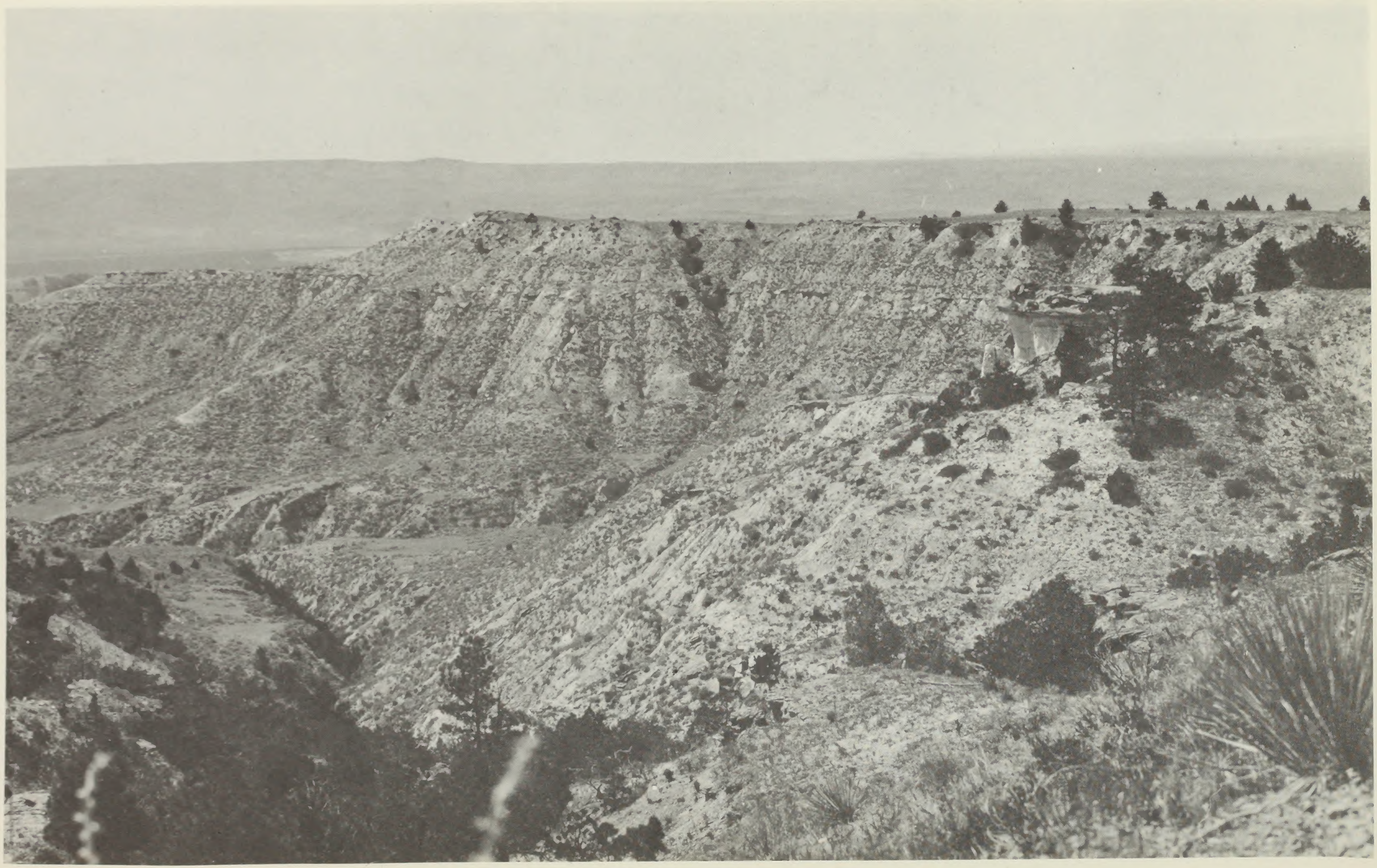


Figure 56 Top photo Stanton, 1900. Bottom photo BLM, 1963. Time span 63 years. About 3 miles northwest of Forsyth, Montana. Timber has increased in size and density. Other vegetation also increased as can be seen on the slope of the hill. The larger gully in the foreground has stabilized and the rate of erosion is in balance.



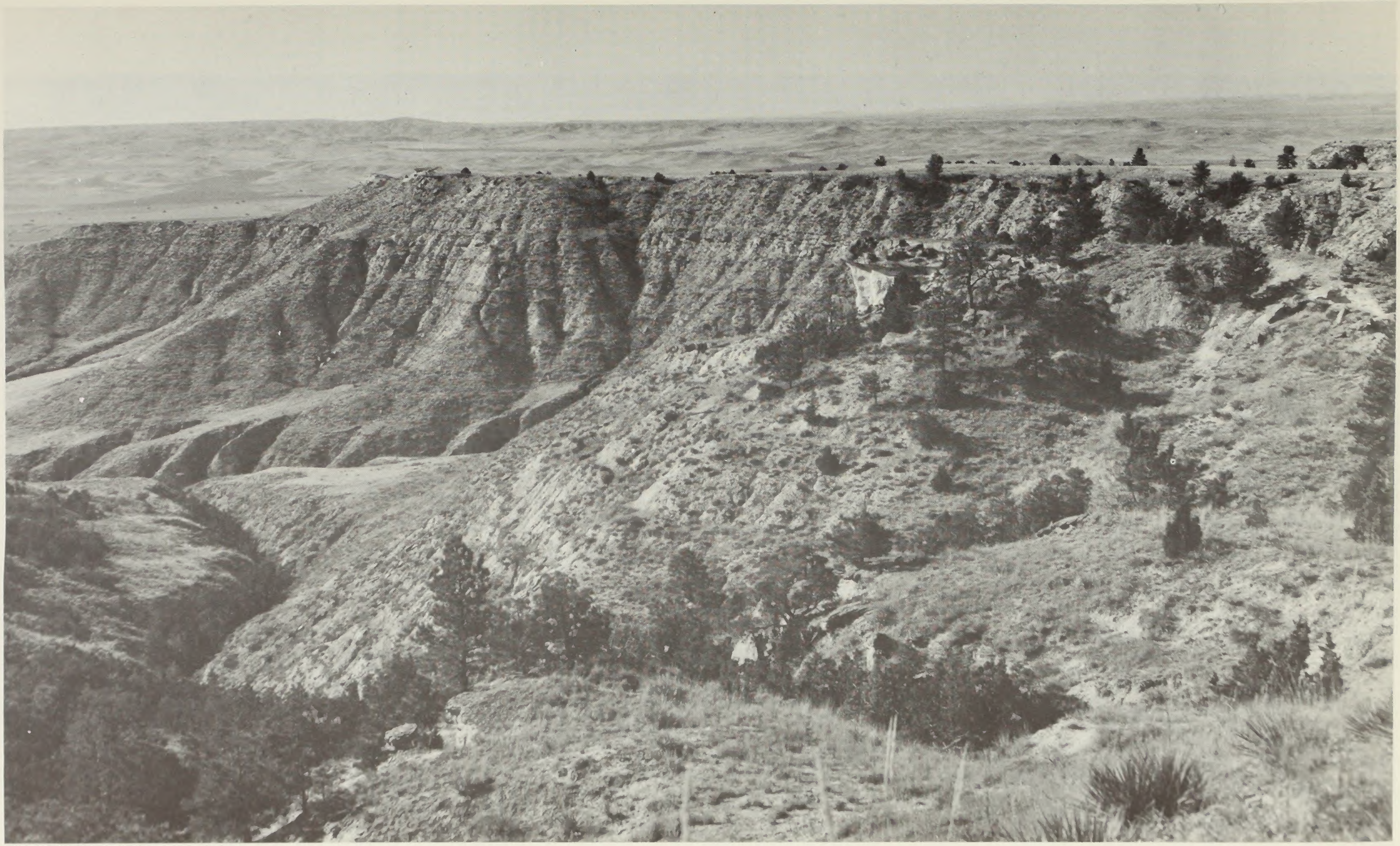
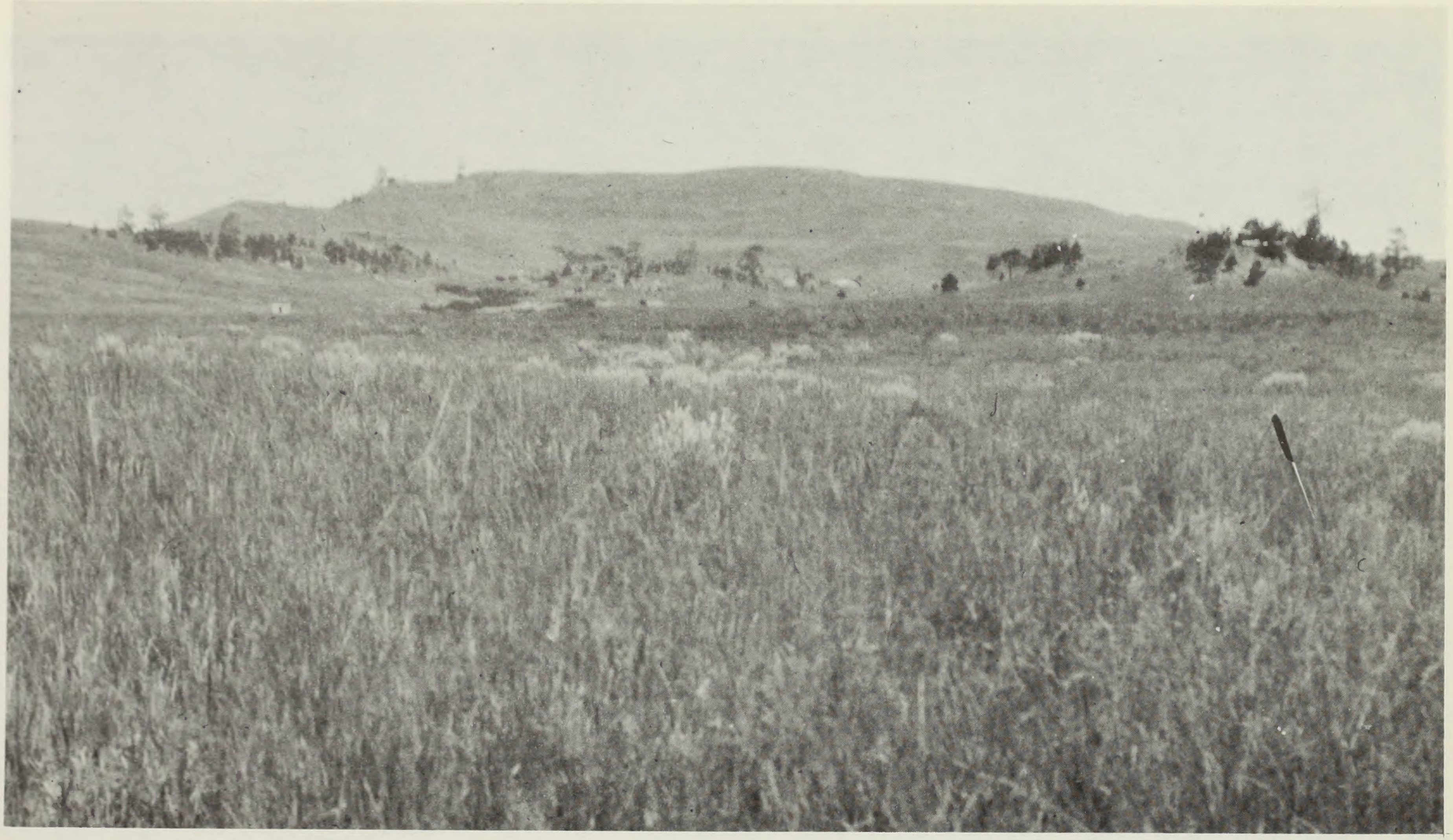


Figure 57 Top photo Pierce, 1930. Bottom photo BLM, 1963. Time span 33 years. South of Rosebud, Montana near Richard Coulee. Timber increased in size and ground cover. Grass density has increased markedly throughout the photograph. Improvement in grass species is also seen in the foreground. The rate of erosion is normal.



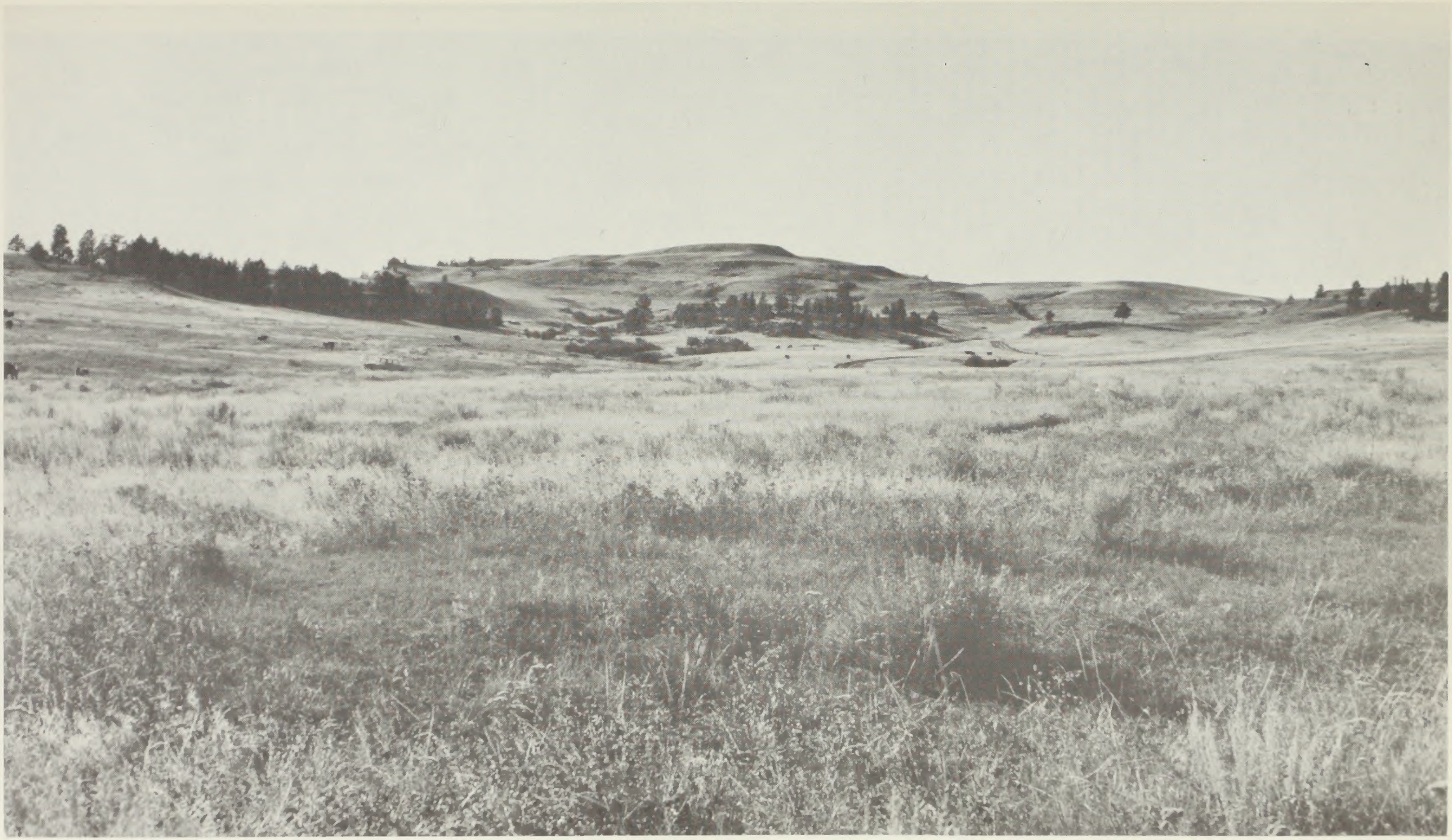
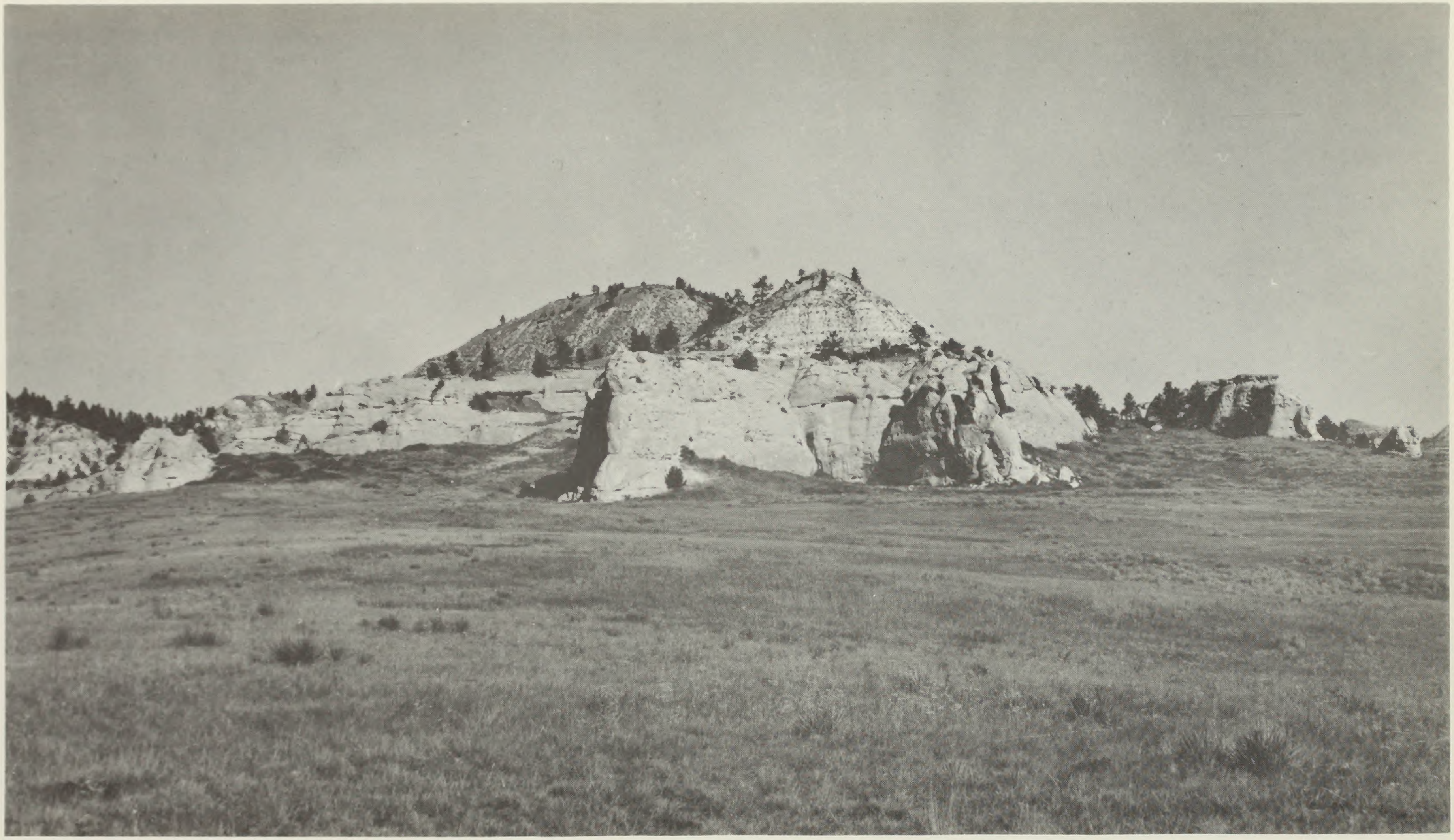


Figure 58 Top photo Baker, 1924. Bottom photo BLM, 1962. Time span 38 years.
On the southern edge of the subbasin. Timber has greatly increased in size and density. Range condition has decreased. Short grasses have replaced tall grasses. Grazing is concentrated in bottom land. Location about 300 feet from original photos; too marshy to reoccupy location of 1924.



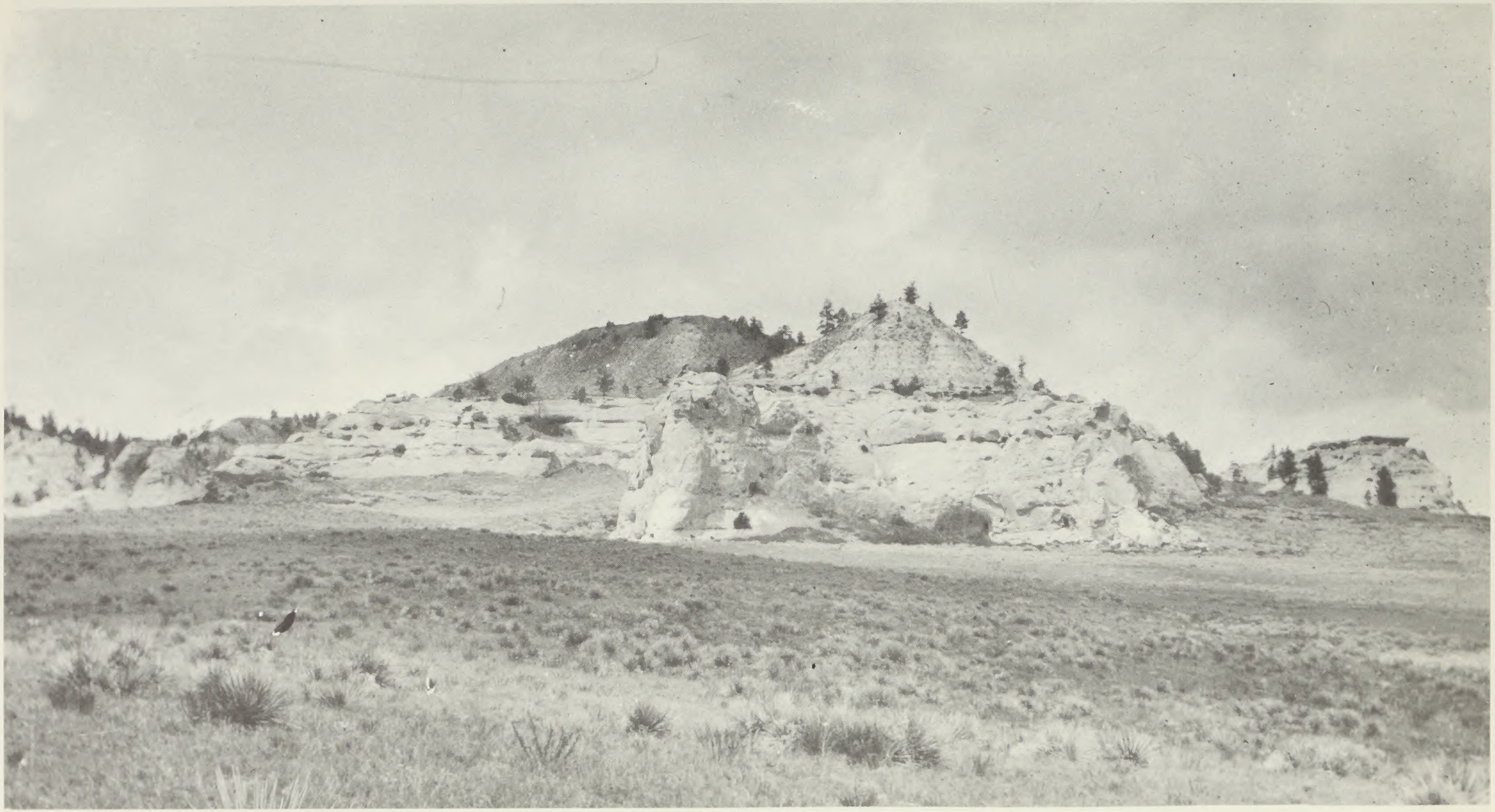
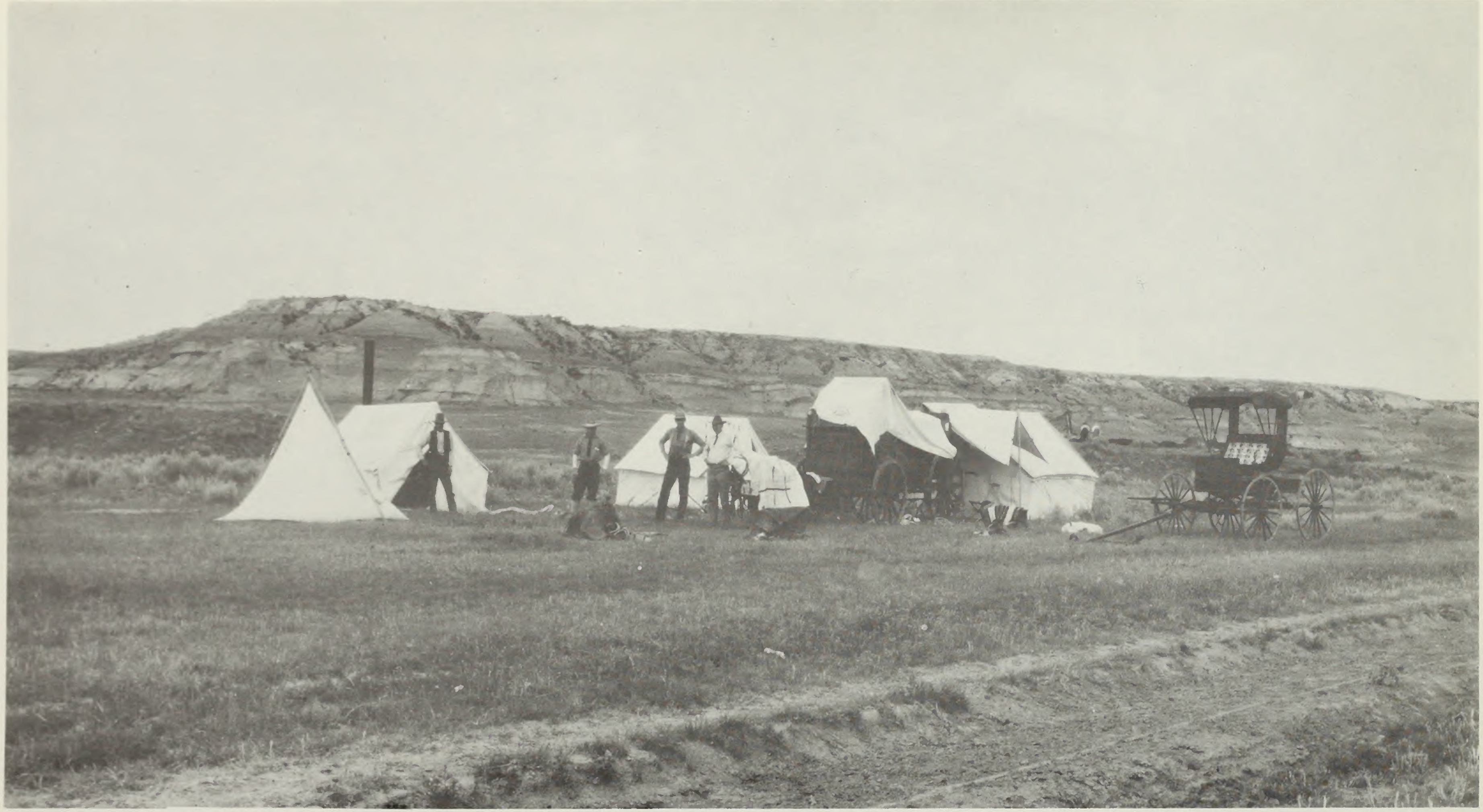


Figure 59 Top photo Dobbin, 1930. Bottom photo BLM, 1963. Time span 33 years. South of Colstrip, Montana near Rosebud Creek. Timber increase is definite. Range condition improved greatly. A good cover of midgrasses has replaced the heavy stand of yucca. The probable reason for disappearance of yucca was the change to winter use of this excellent pasture.



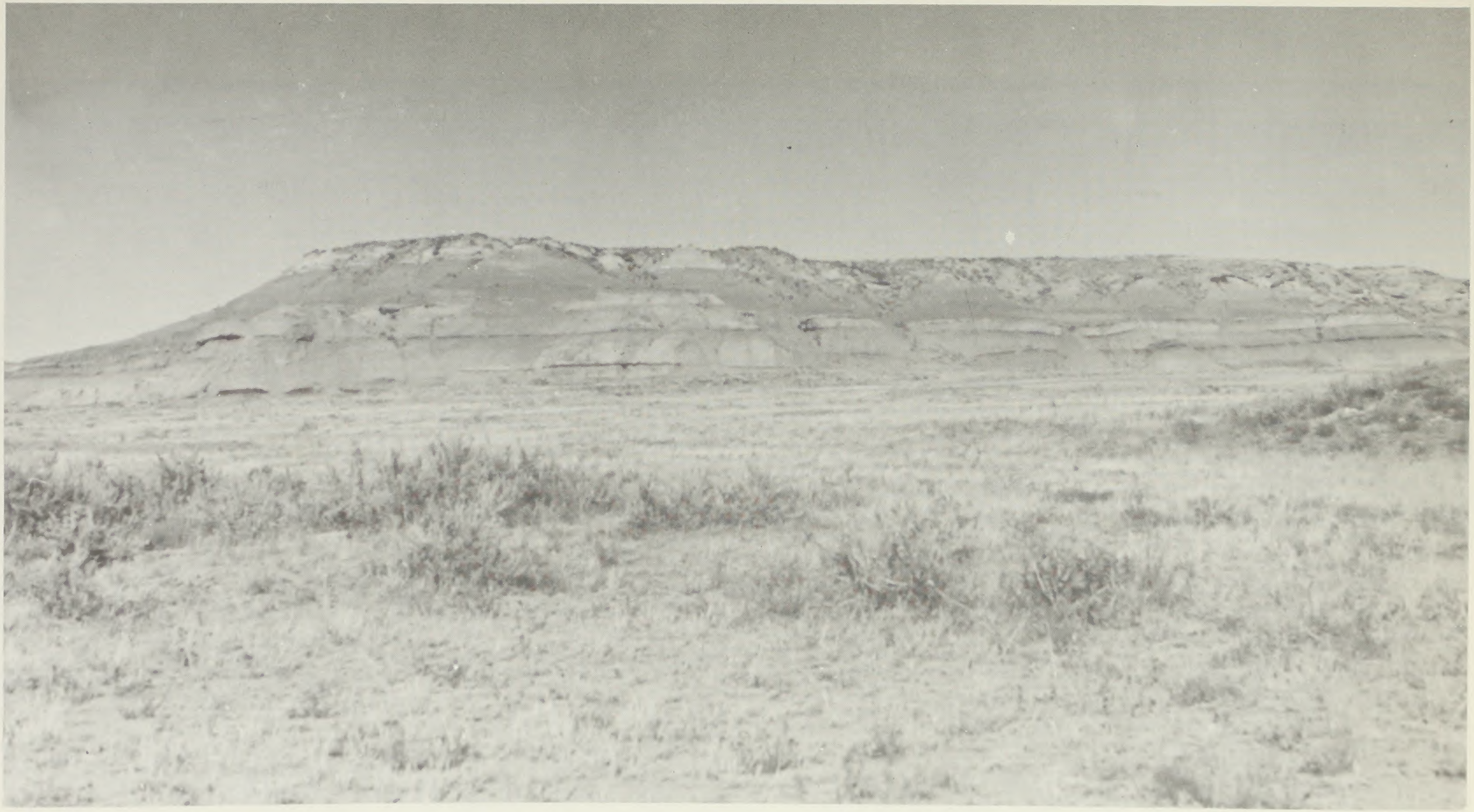
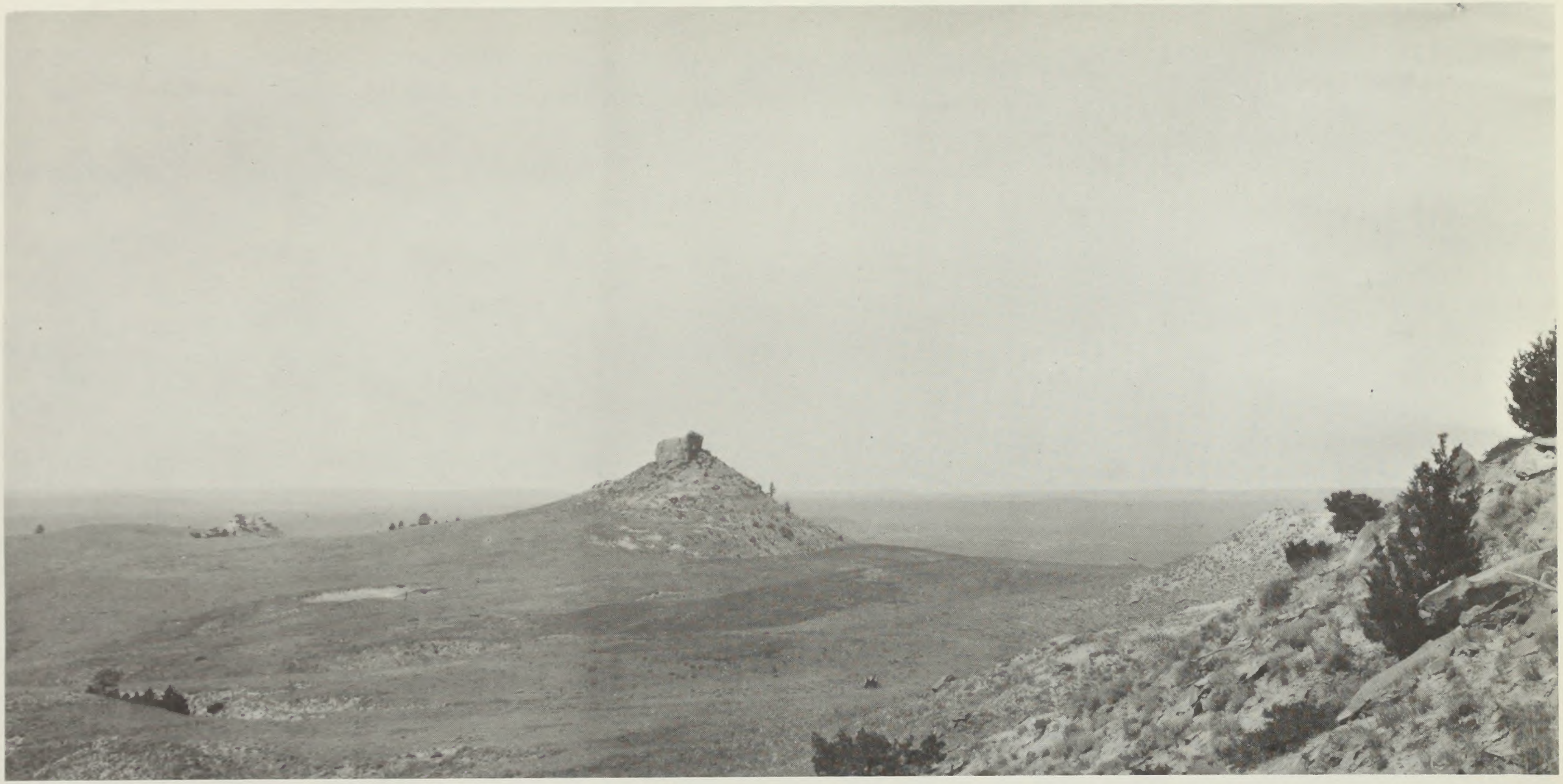


Figure 60 Top photo Collier, 1907. Bottom photo BLM, 1962. Time span 55 years. Near Miles City, Montana. Sagebrush increased in density, while other vegetation decreased. Rate of erosion also increased. Area is greatly disturbed by past mining activities (tailings in pile at right center) and todays off road traffic.



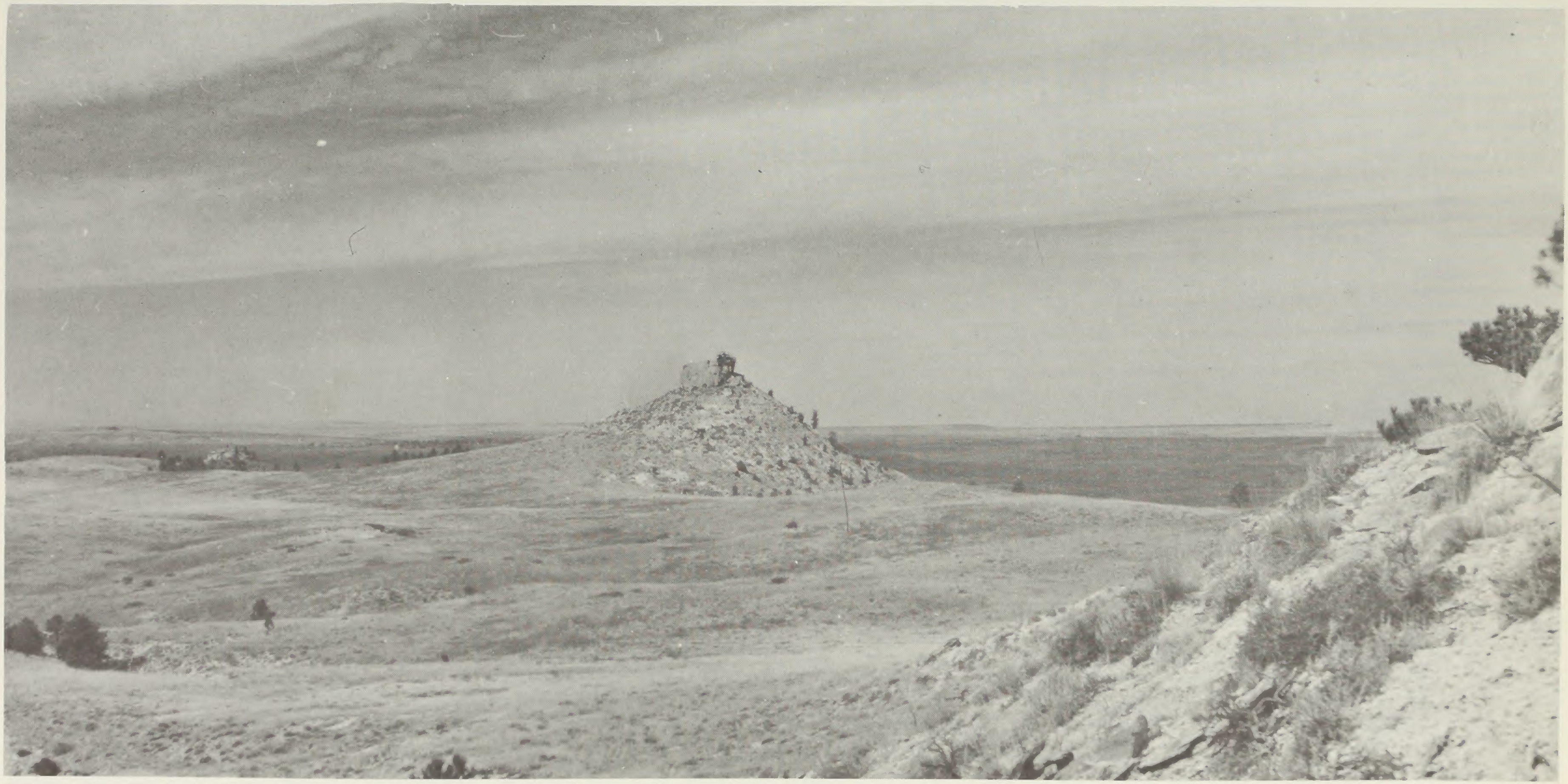
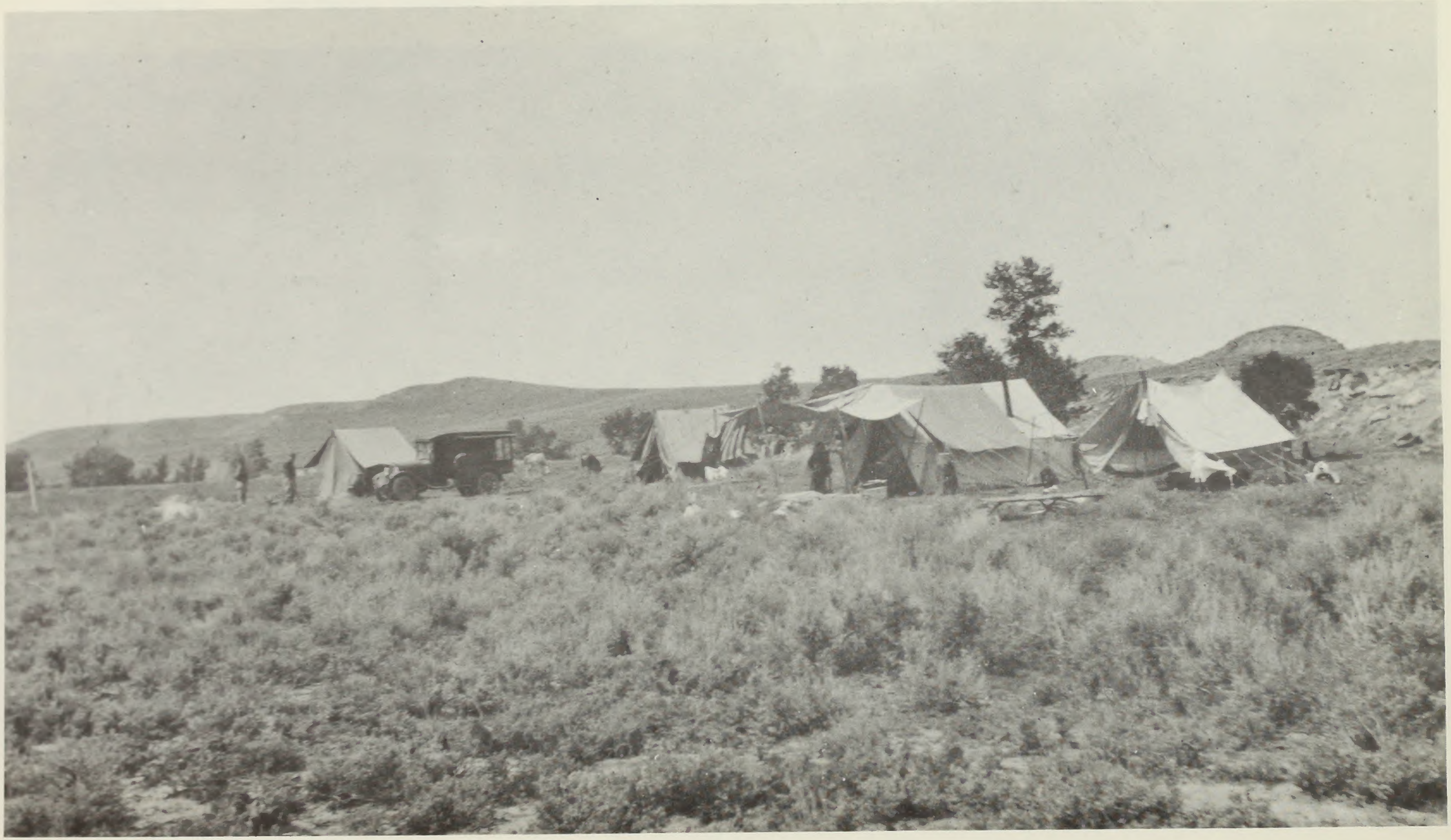


Figure 61 Top photo Stanton, 1900. Bottom photo BLM, 1963. Time span 63 years. Recovery point is roughly 30 feet to the right of original location. Midgrasses, principally little bluestem and prairie sandreed grass, have extended their territory. Active wind erosion (mid-left) in 1900 has been stabilized. Trees have increased, especially in the distance. Bunch grasses in foreground have not changed in species or density.



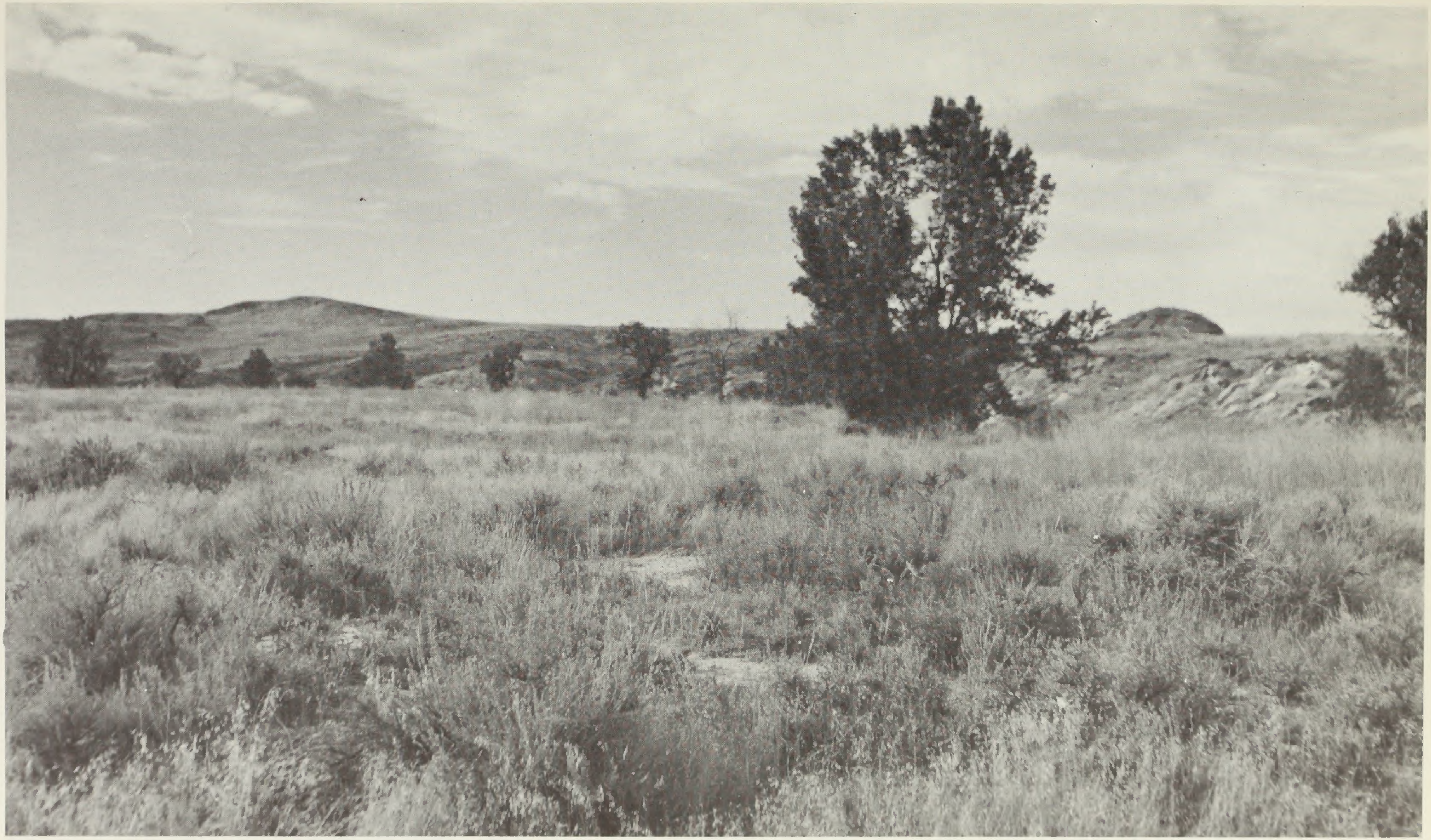
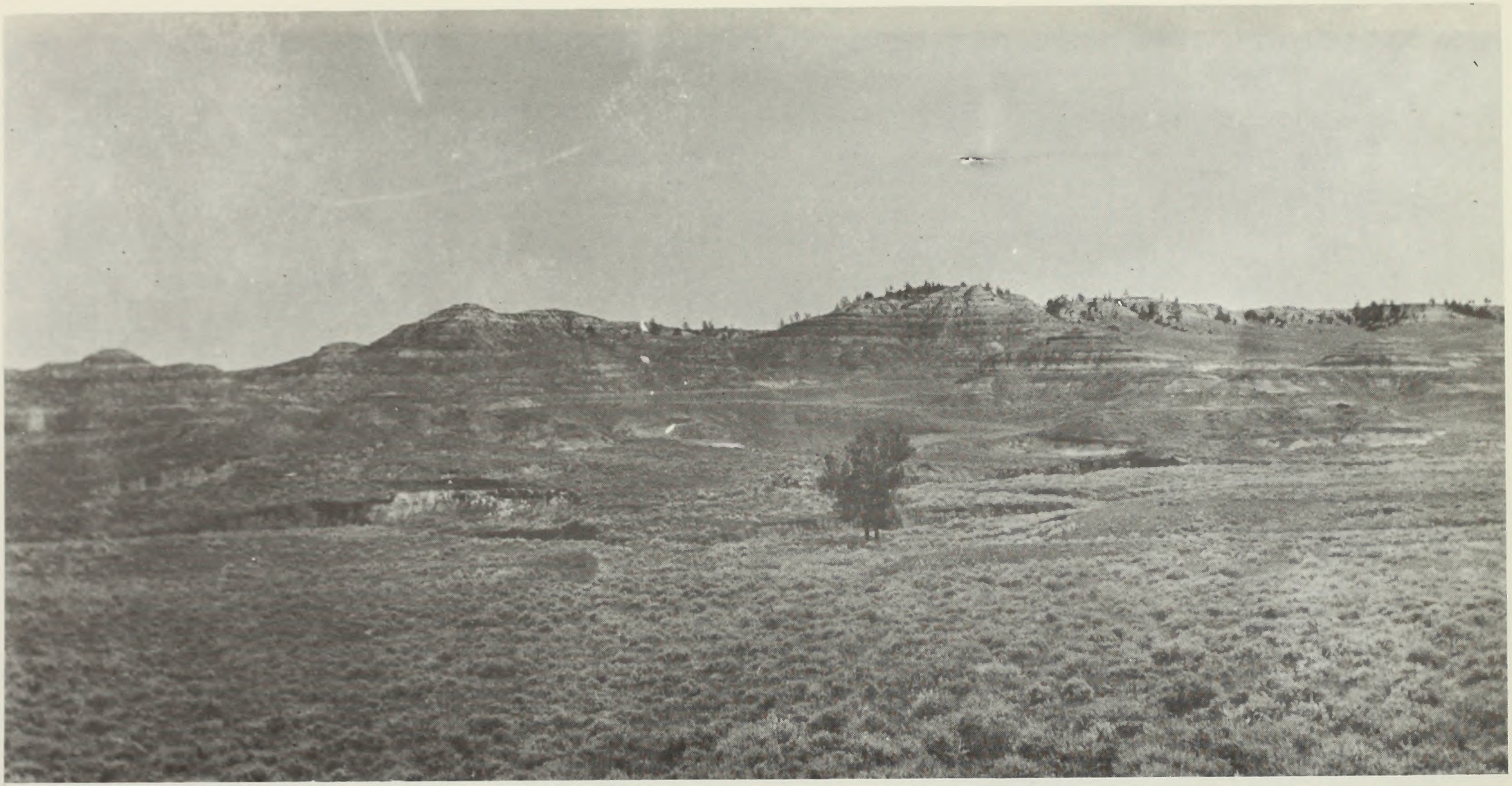


Figure 62 Top photo Dobbin, 1930. Bottom photo BLM, 1963. Time span 33 years. South of Forsyth, Montana 300 yards from Rosebud Creek. In the center of the photos, the cottonwoods have extended up the draw. Range condition has improved. Grasses have replaced a part of the sagebrush, and the rate of erosion is reduced.



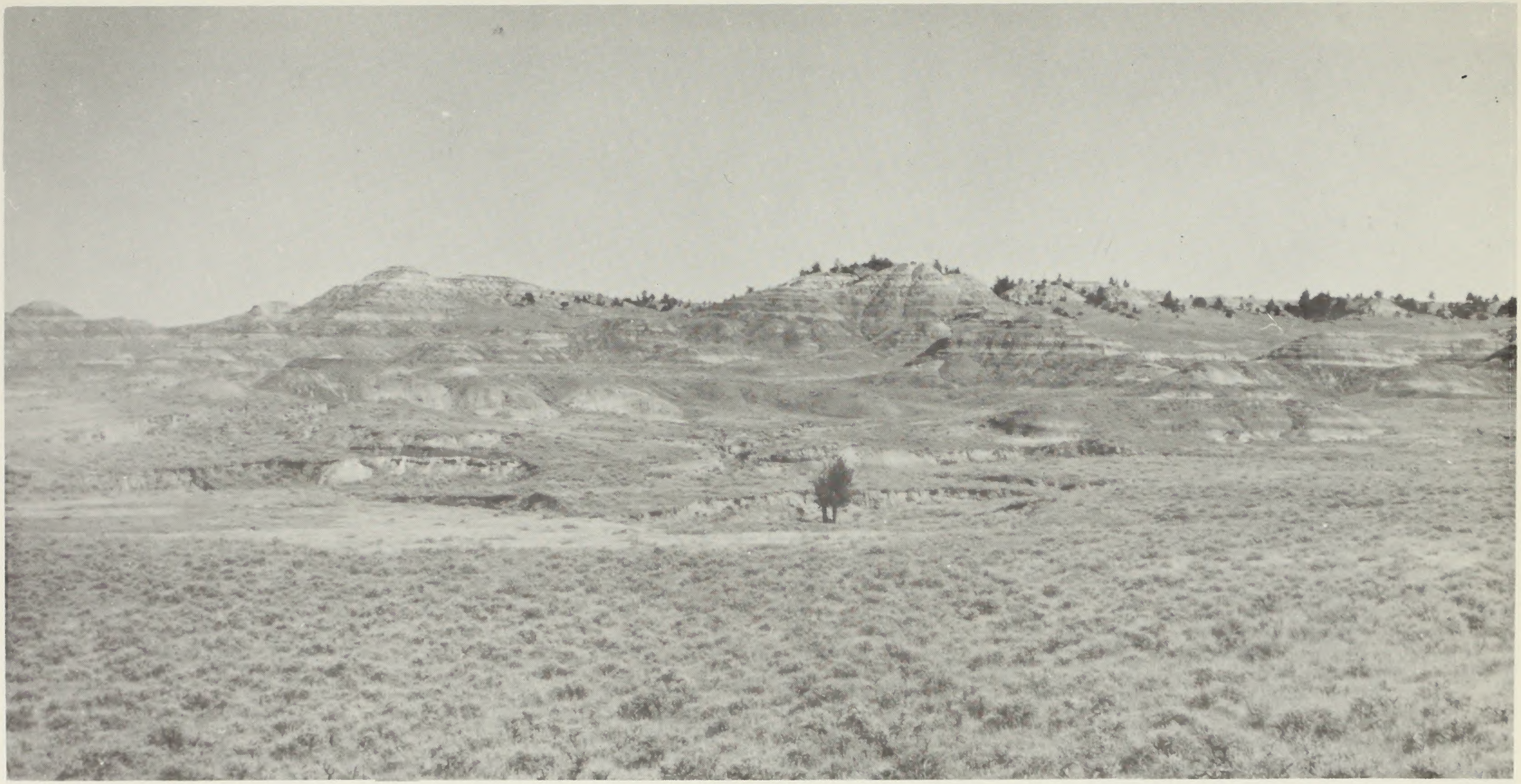
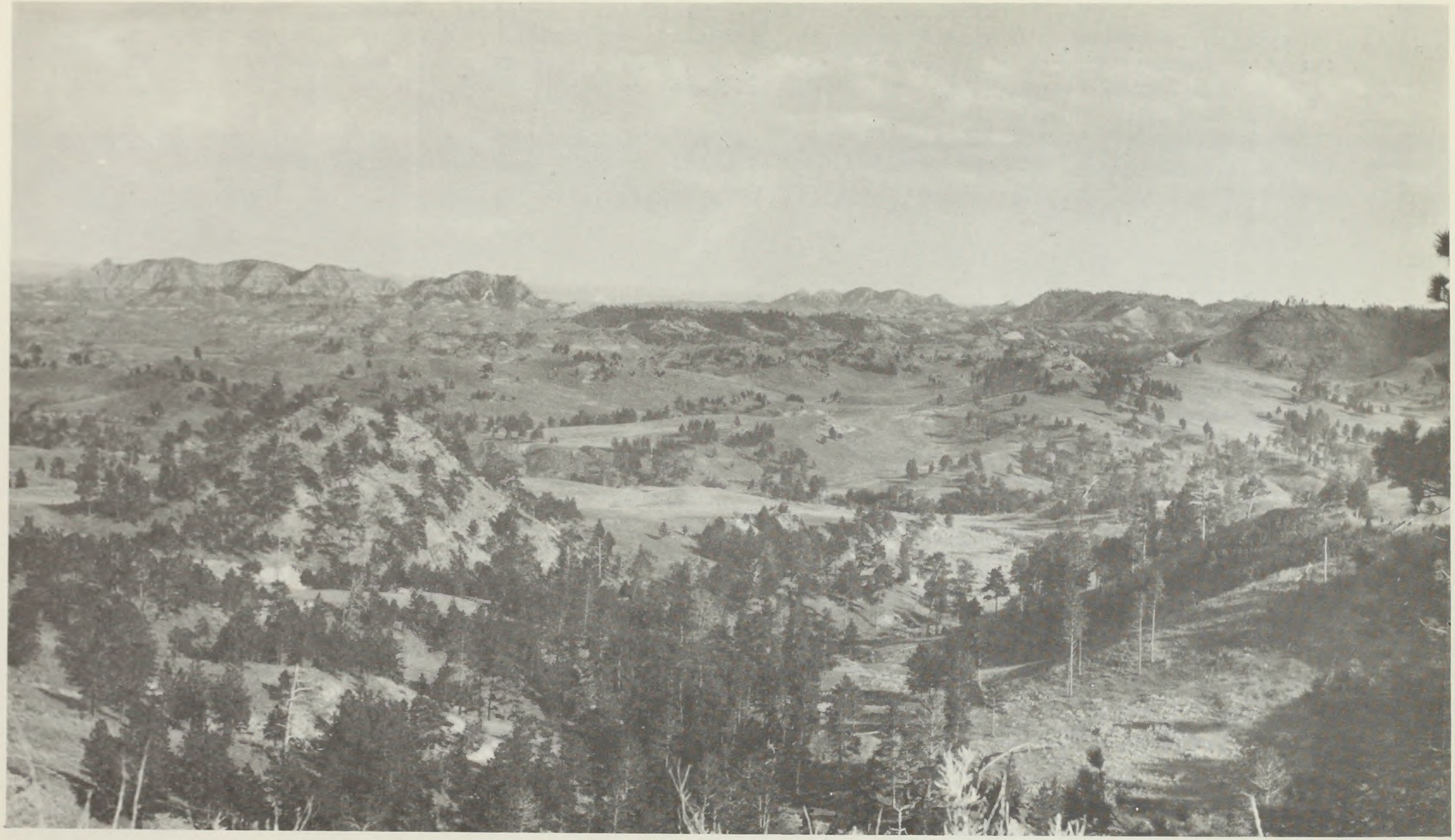


Figure 63 Top photo Dobbin, 1930. Bottom photo BLM, 1963. Time span 33 years. In the foreground the grass has increased but no change is discernible in size, number of plants, or vigor of big sagebrush. Along the draw, however, sagebrush plants have decreased in number, and grass has increased. Ponderosa pine on the ridges seems unchanged.



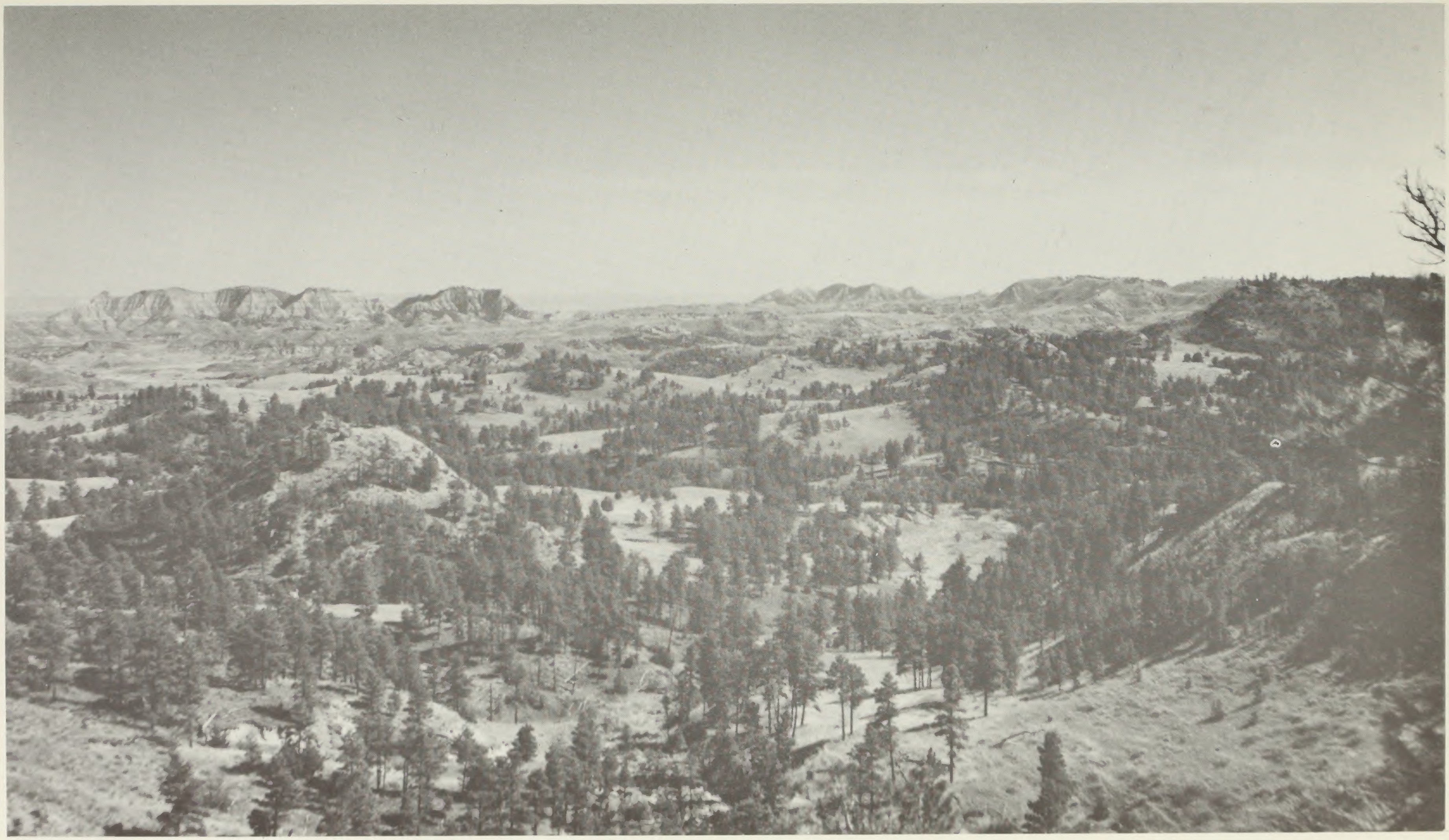
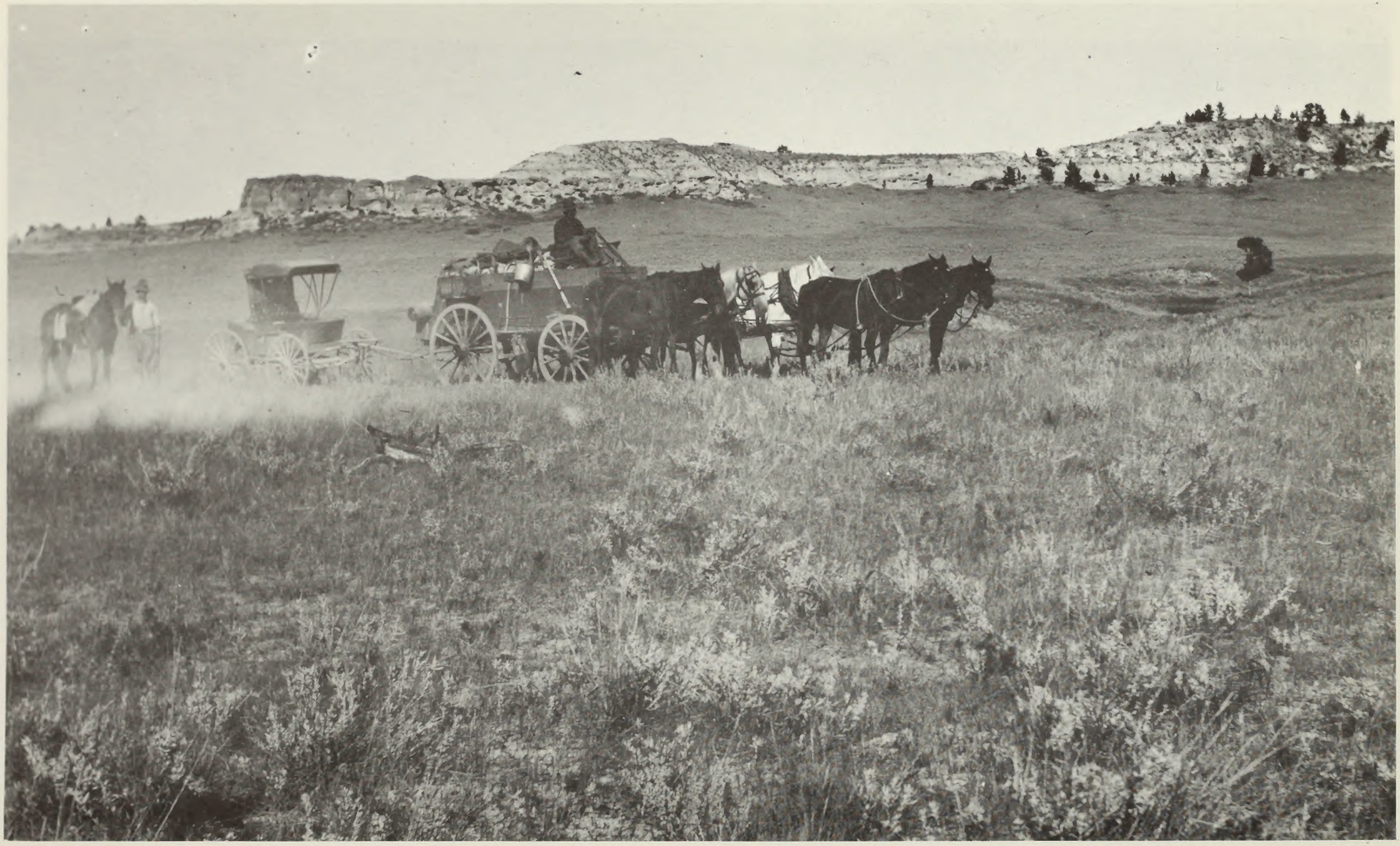


Figure 64 Top photo Collier, 1907. Bottom photo BLM, 1962. Time span 55 years. About 15 miles southeast of Miles City, Montana. Timber has increased markedly in size and amount of ground covered. Range condition has improved and the rate of erosion has decreased.



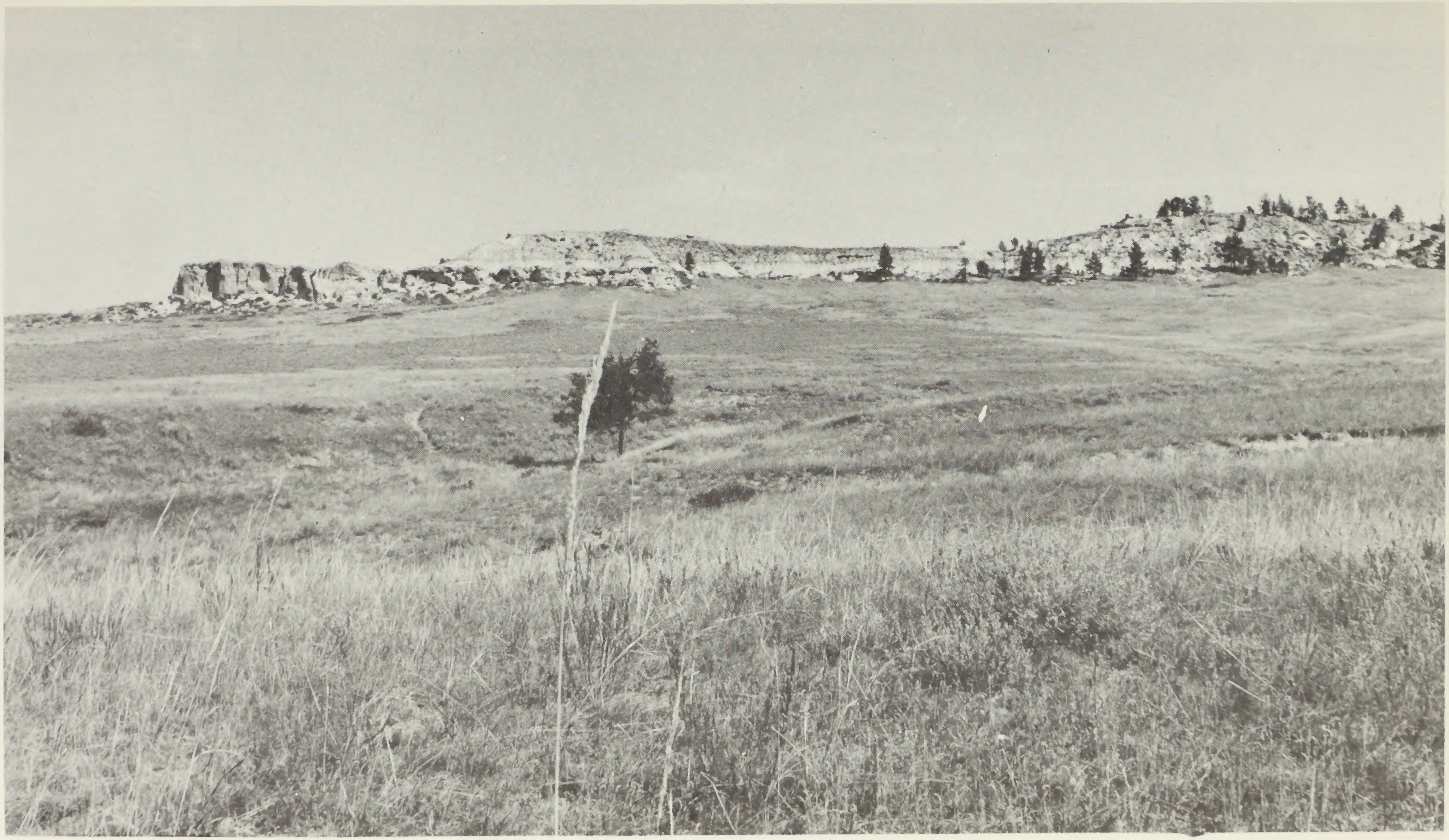
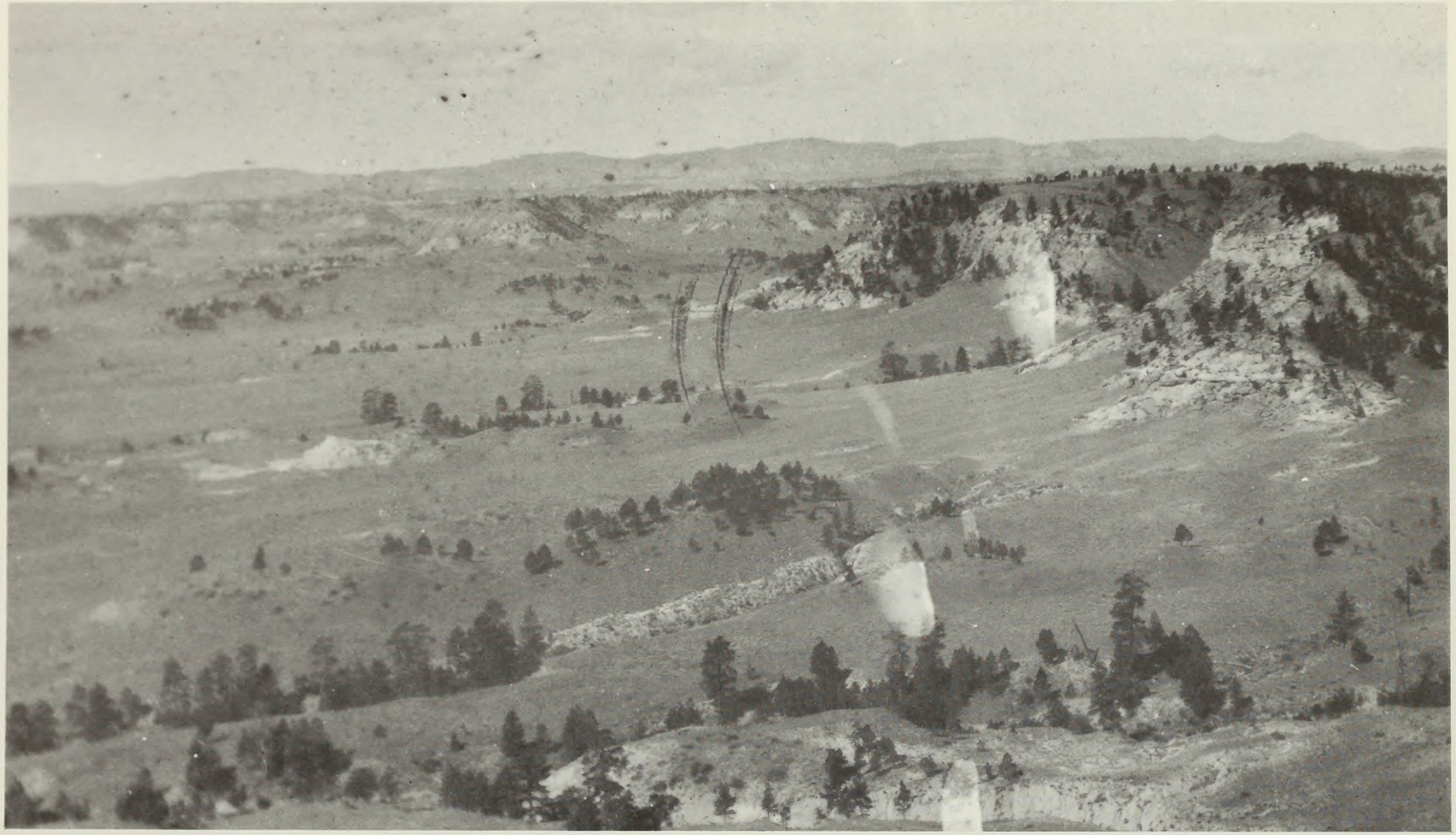


Figure 65 Top photo Lupton, 1909. Bottom photo BLM, 1963. Time span 54 years. South of Rosebud, Montana near Rosebud Creek. Timber increased in size and tree numbers. Range condition has improved. Plant density increased and grasses have replaced the sagebrush. A new small dam lies above the cottonwood in the draw. The ranch cook, in 1909, is on his way to the fall roundup.



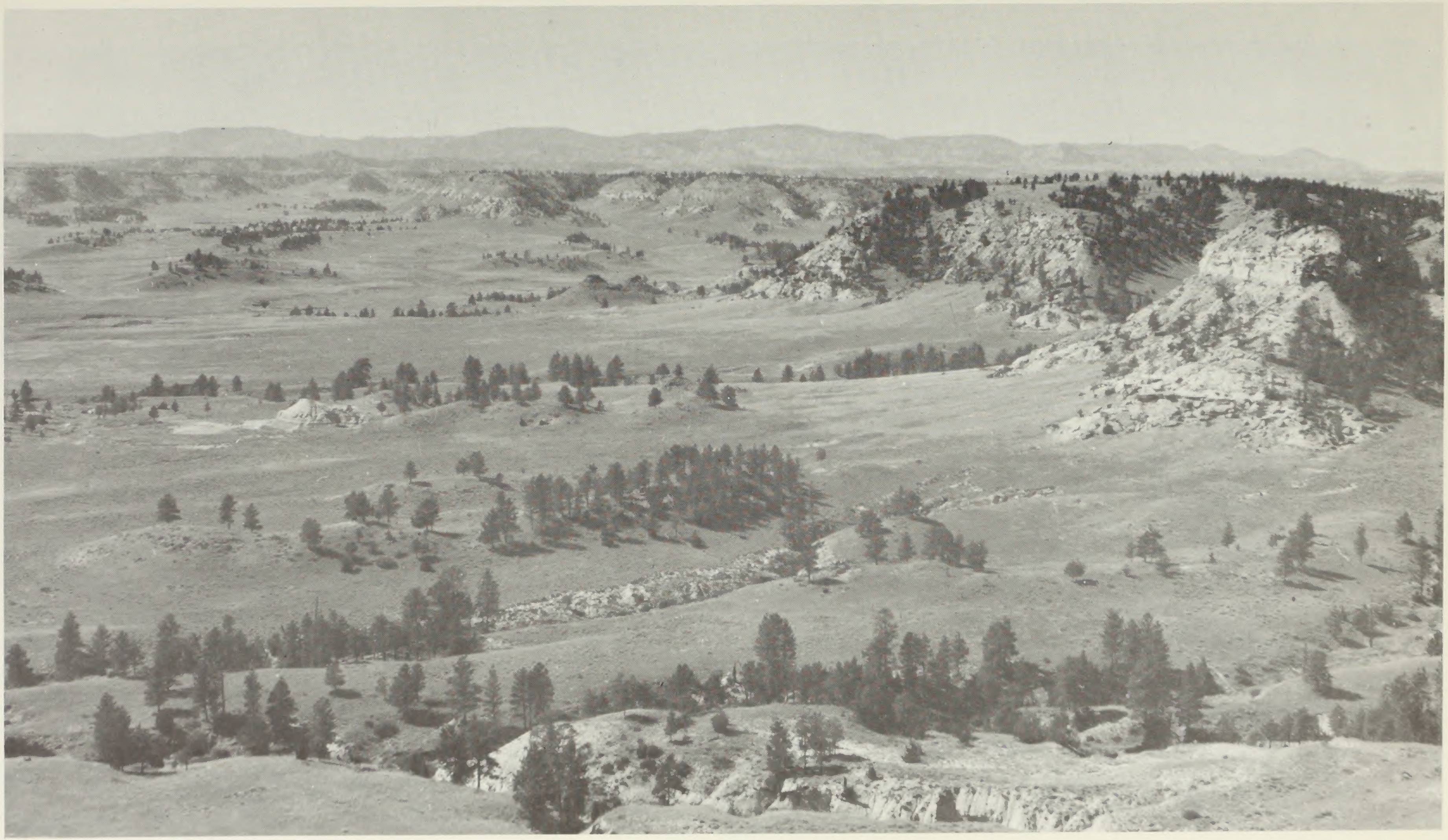
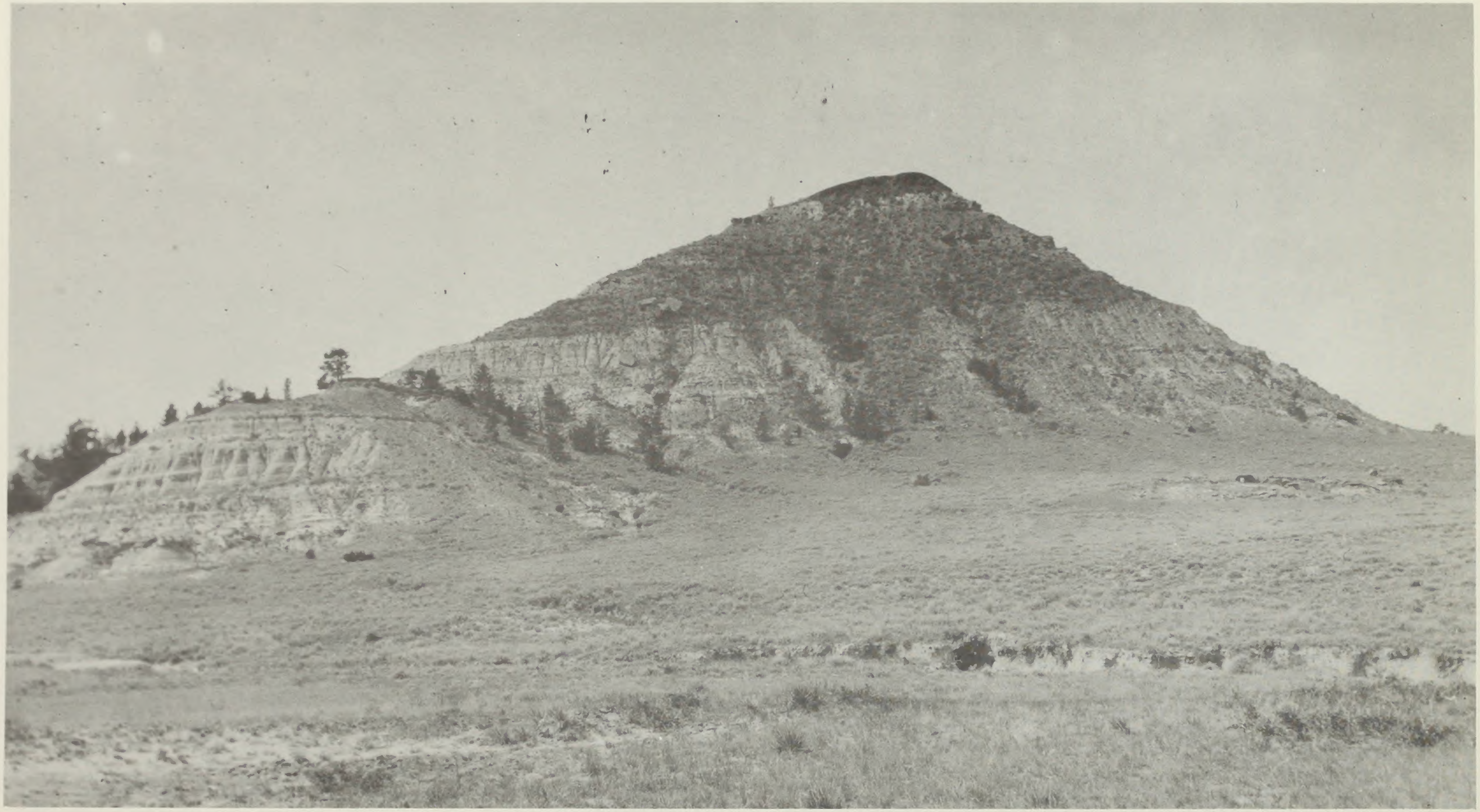


Figure 66 Top photo Dobbin, 1930. Bottom photo BLM, 1963. Time span 33 years. Gullies have changed little; possible headcutting on gully in right midphoto. Scattered curl leaf mahogany has disappeared. Sagebrush has increased. Timber has increased in number of trees and area occupied.



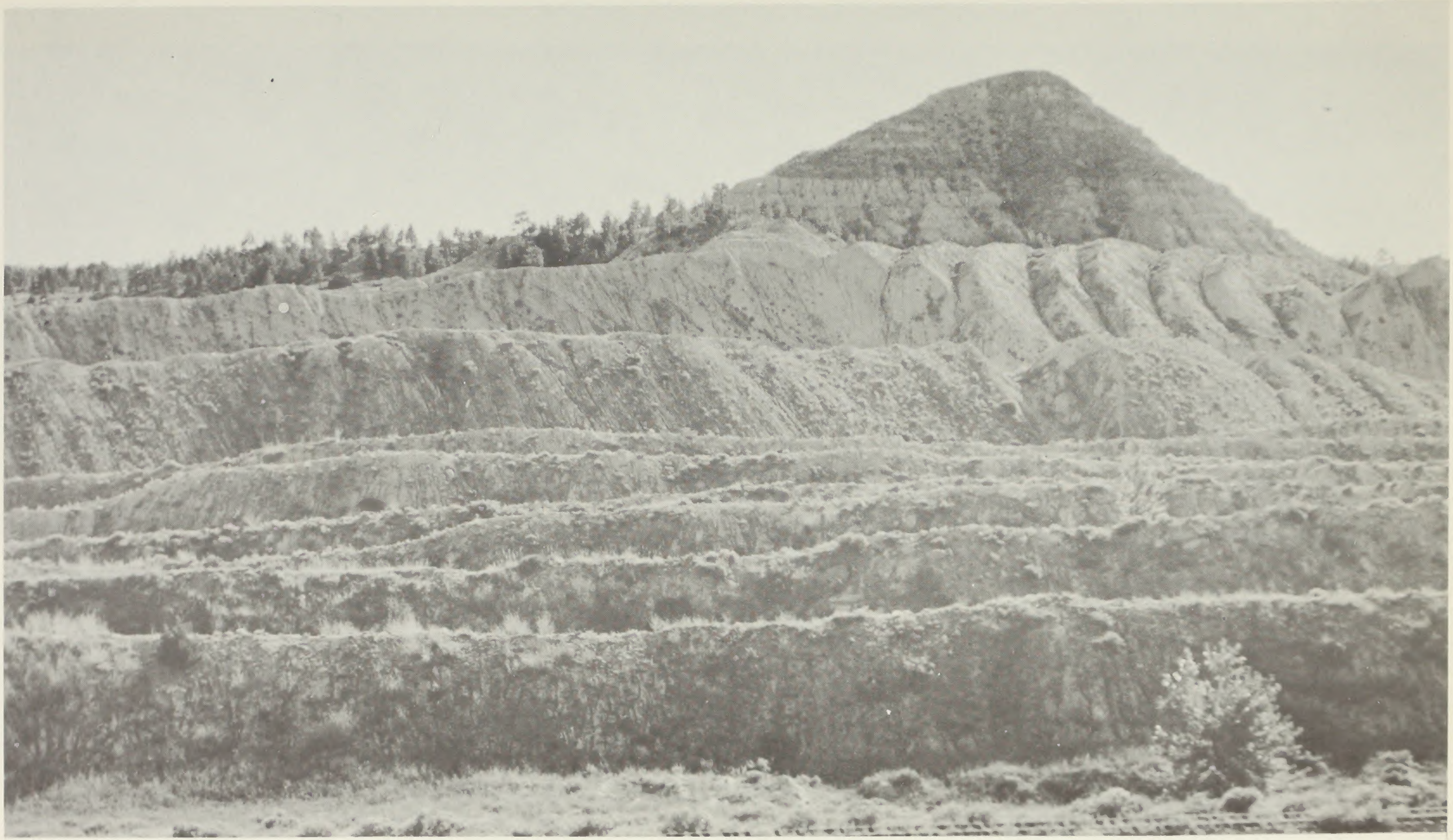
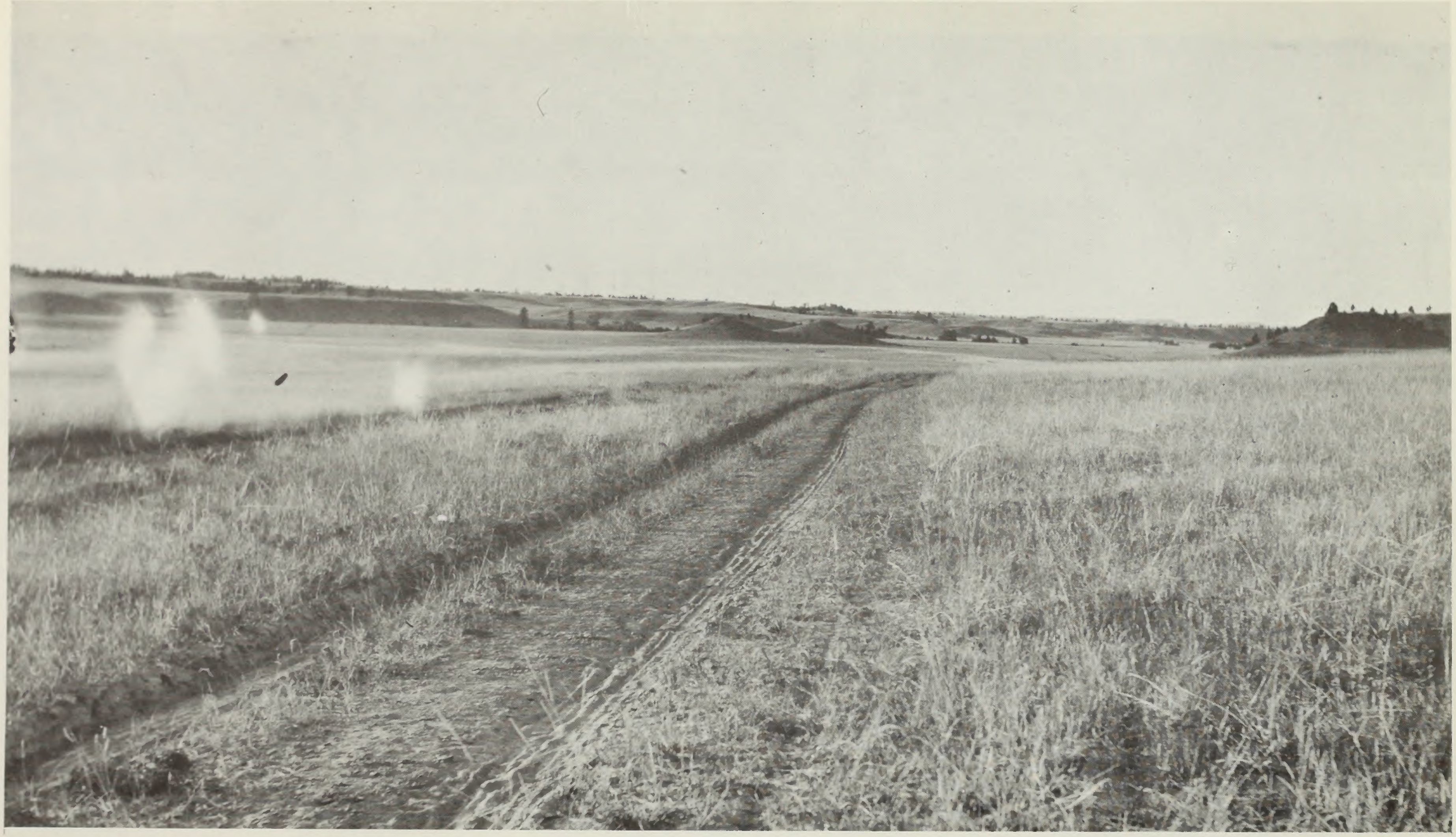


Figure 67   Top photo Dobbin, 1930. Bottom photo BLM, 1963. Time span 33 years. Timber has increased markedly in the distance. Strip mining for coal has greatly disturbed the foreground. Rates of revegetation may be seen by comparing the strips. The oldest strips are nearest the camera.



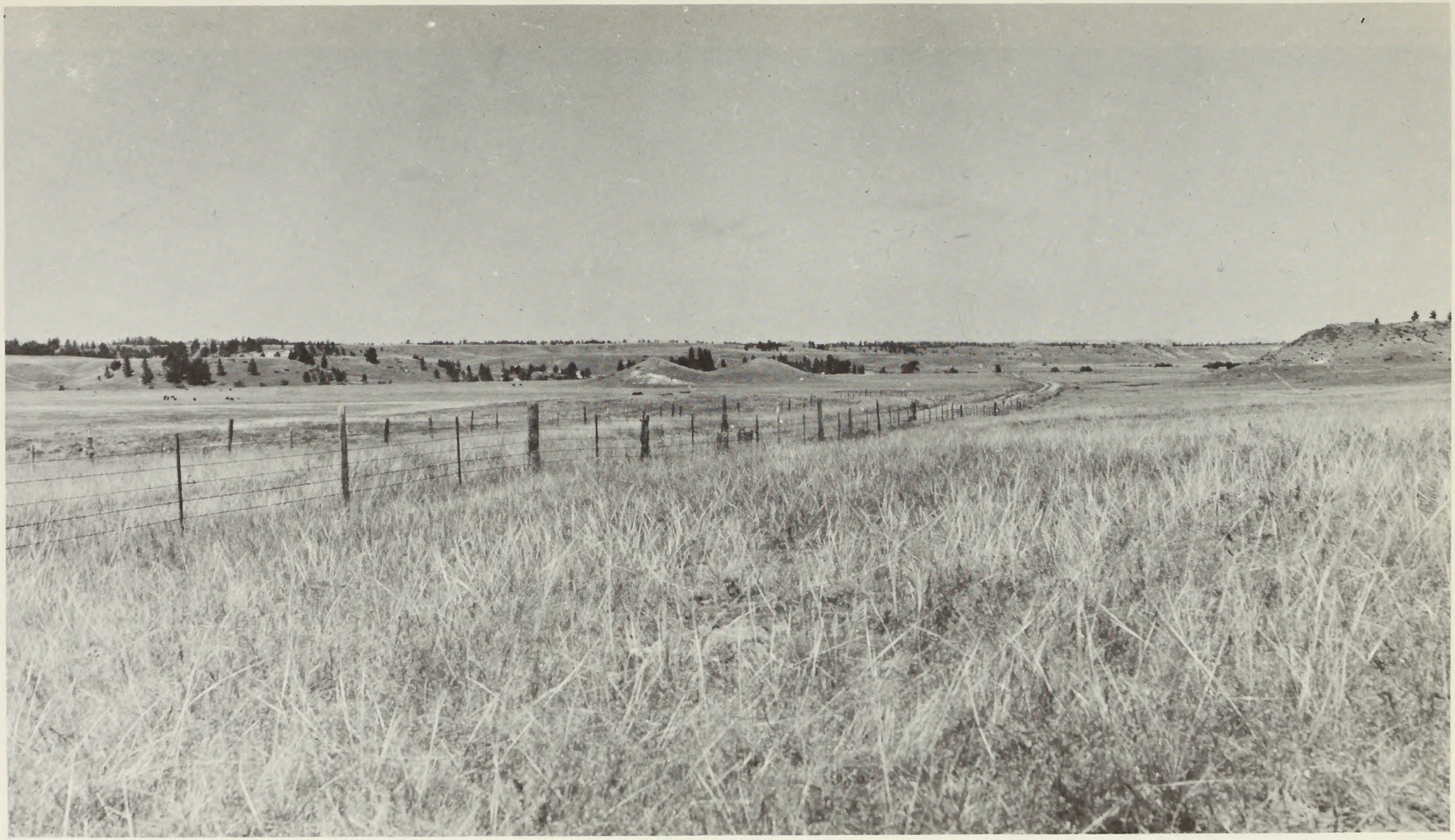
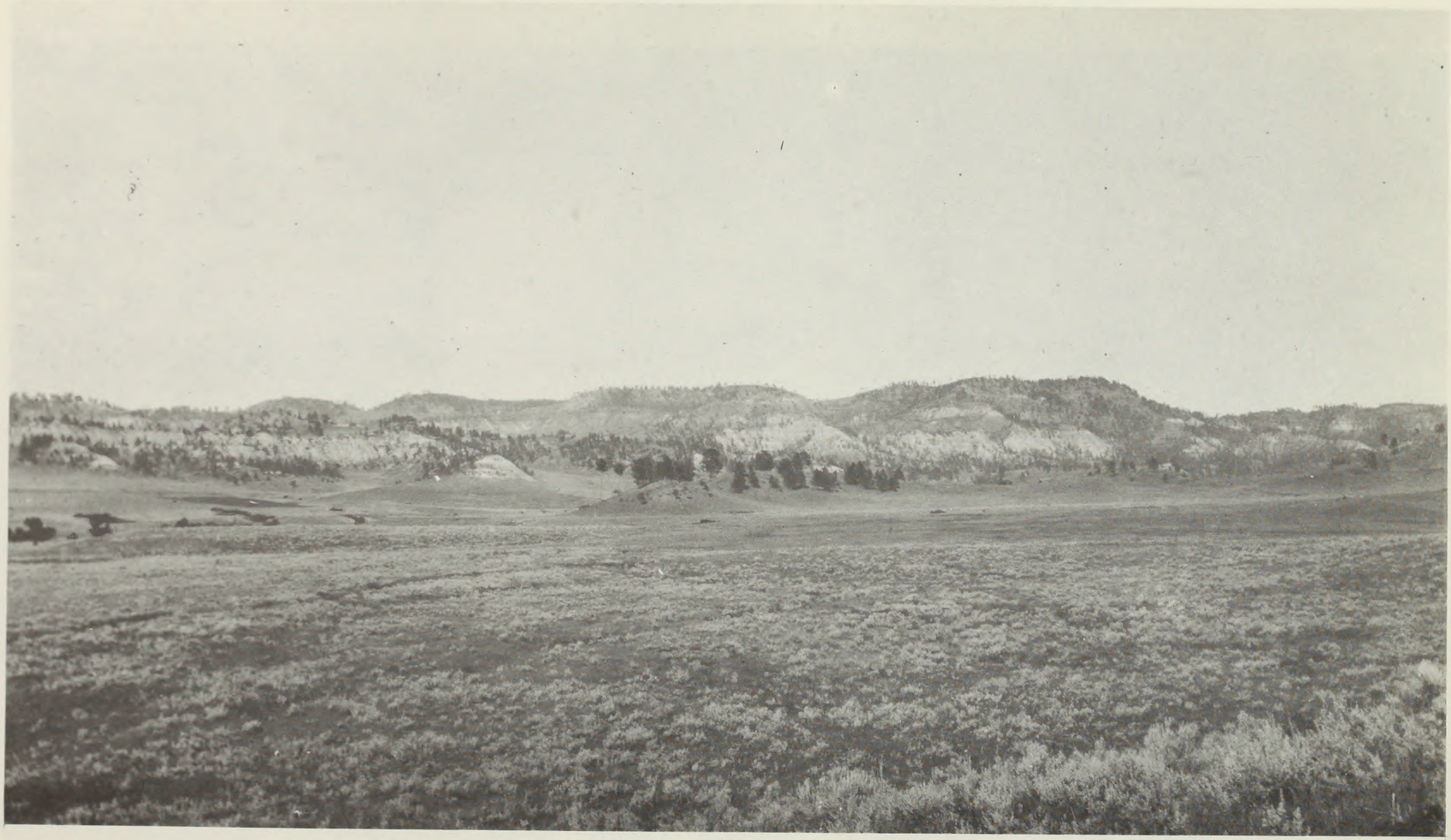


Figure 68 Top photo Lupton, 1909. Bottom photo BLM, 1963. Time span 54 years. South of Forsyth, Montana near the divide of the Tongue River and Greenleaf Creek. Timber increased in both size and density. Range vegetation and rate of erosion both remain in balance.



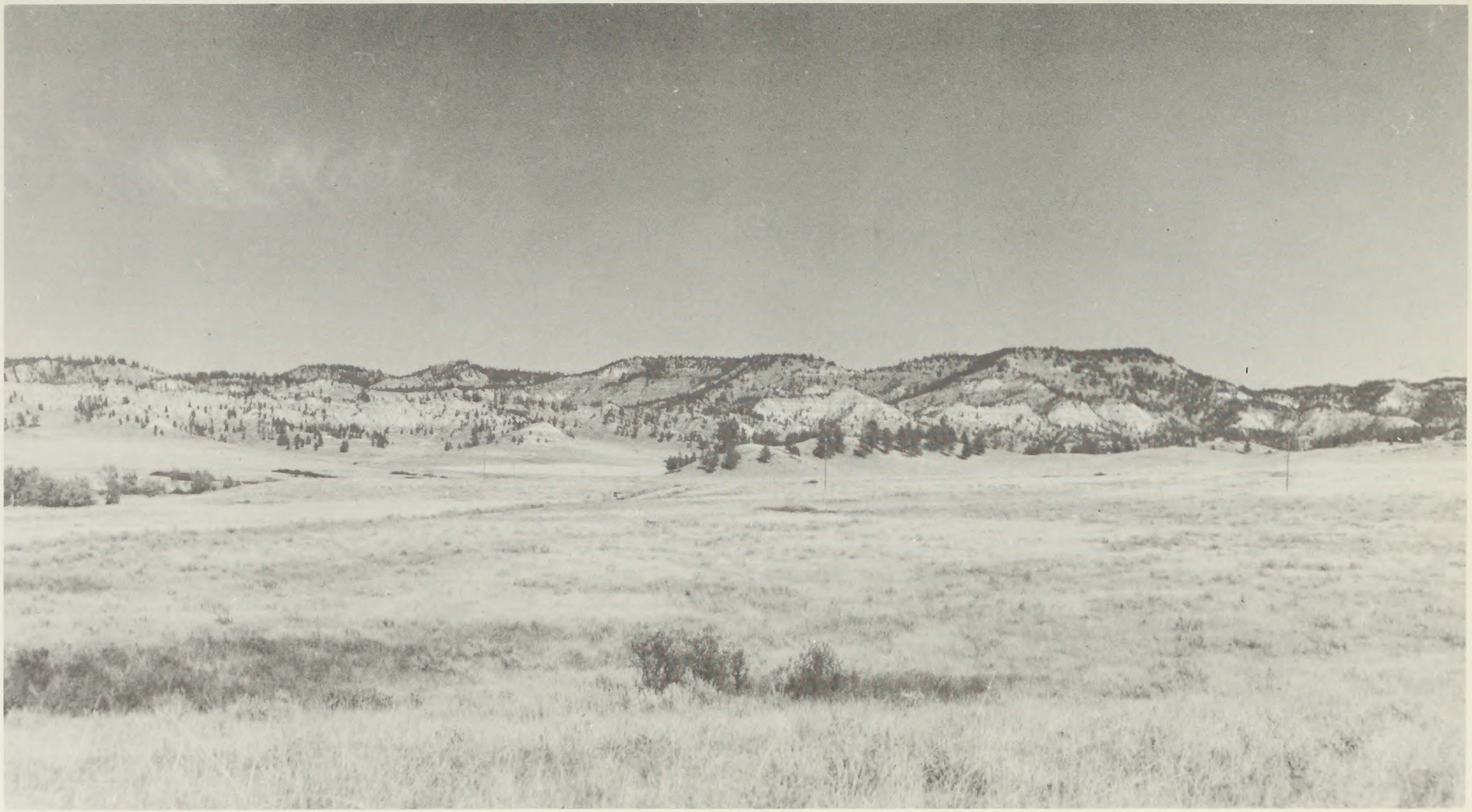
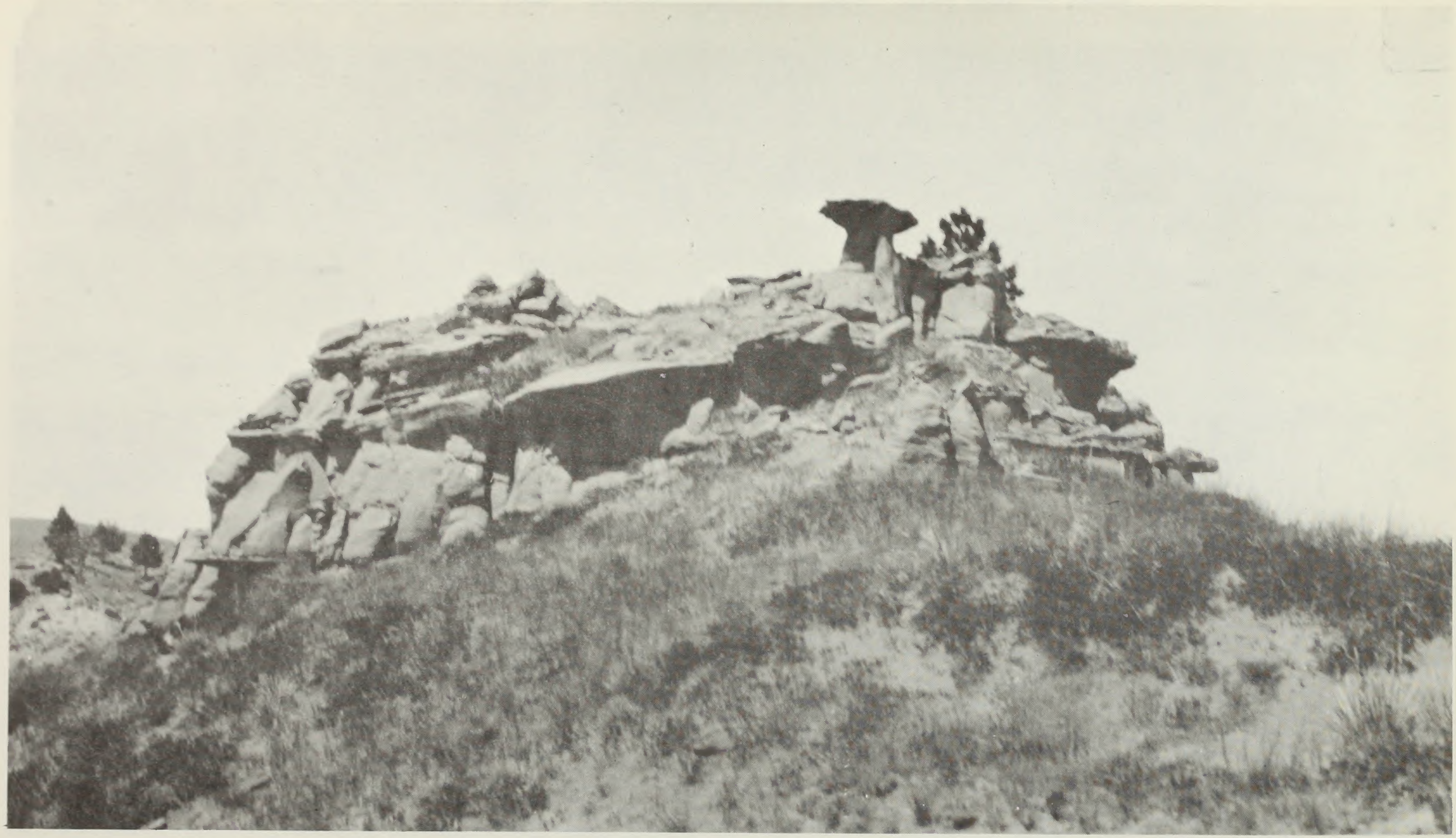


Figure 69 Top photo Dobbin, 1930. Bottom photo BLM, 1963. Time span 33 years. Southwest of Forsyth, Montana near the Wolf Mountains. Timber has increased in size and amount of ground covered near the centers of the photos. Range condition has improved. Tall grasses have replaced short grasses and sagebrush has decreased in density. Rate of erosion has decreased.



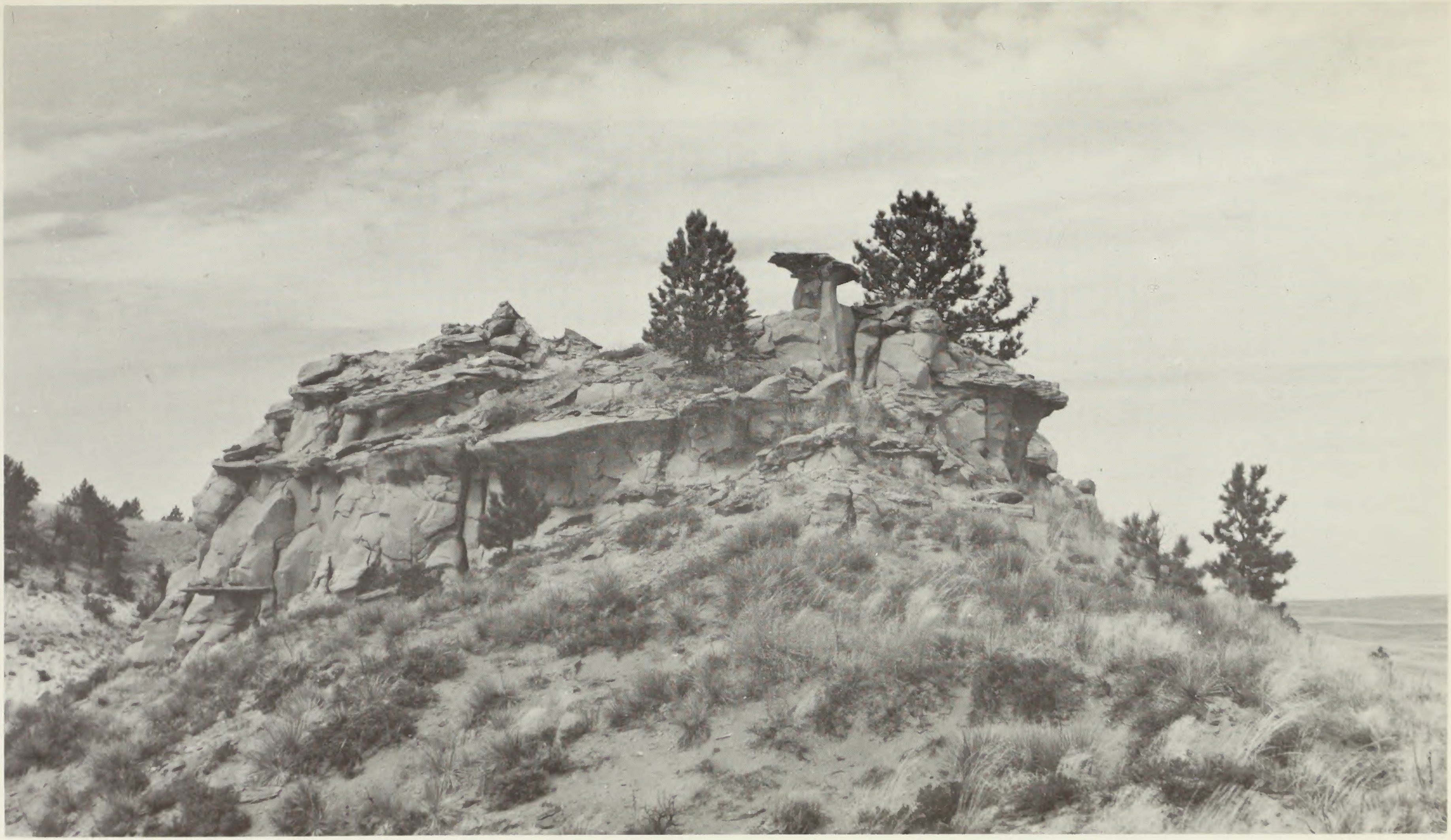
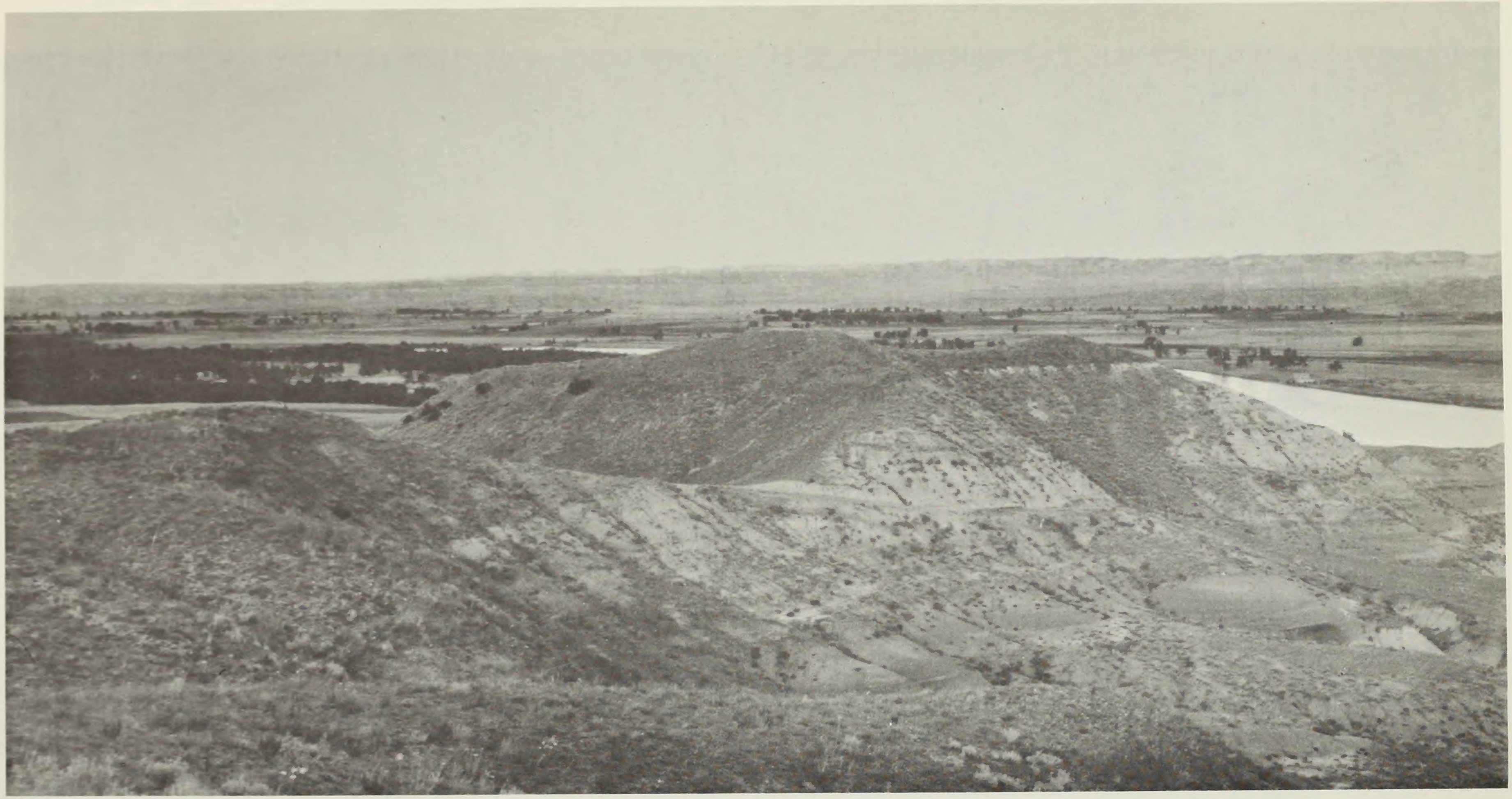


Figure 70 Top photo Stanton, 1900. Bottom photo BLM, 1963. Time span 63 years. About 3 miles northwest of Forsyth, Montana. Original vegetation was skunkbrush and tall sandreed grass, but yucca has increased and the range condition has deteriorated. Rate of wind erosion has increased.



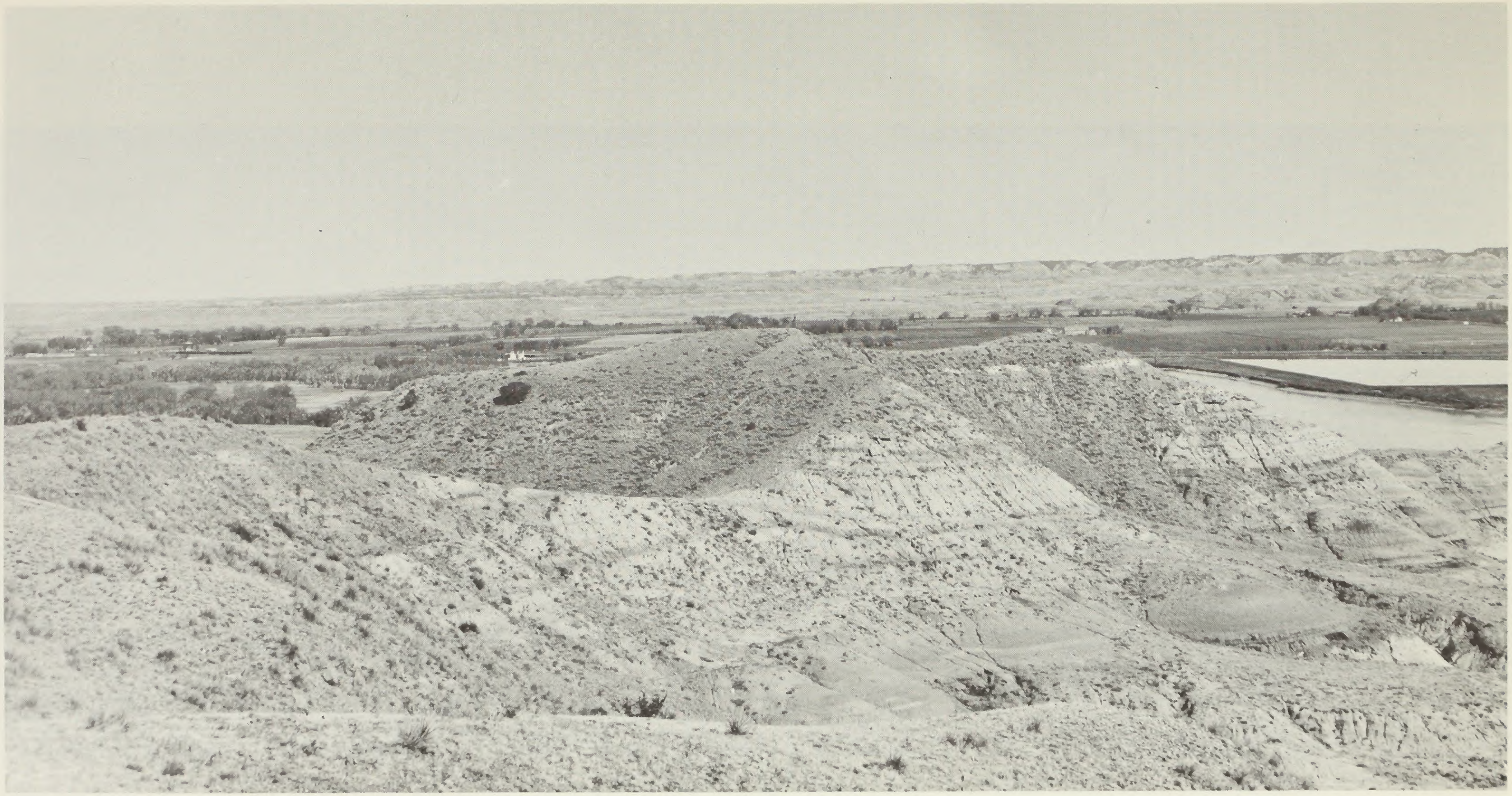
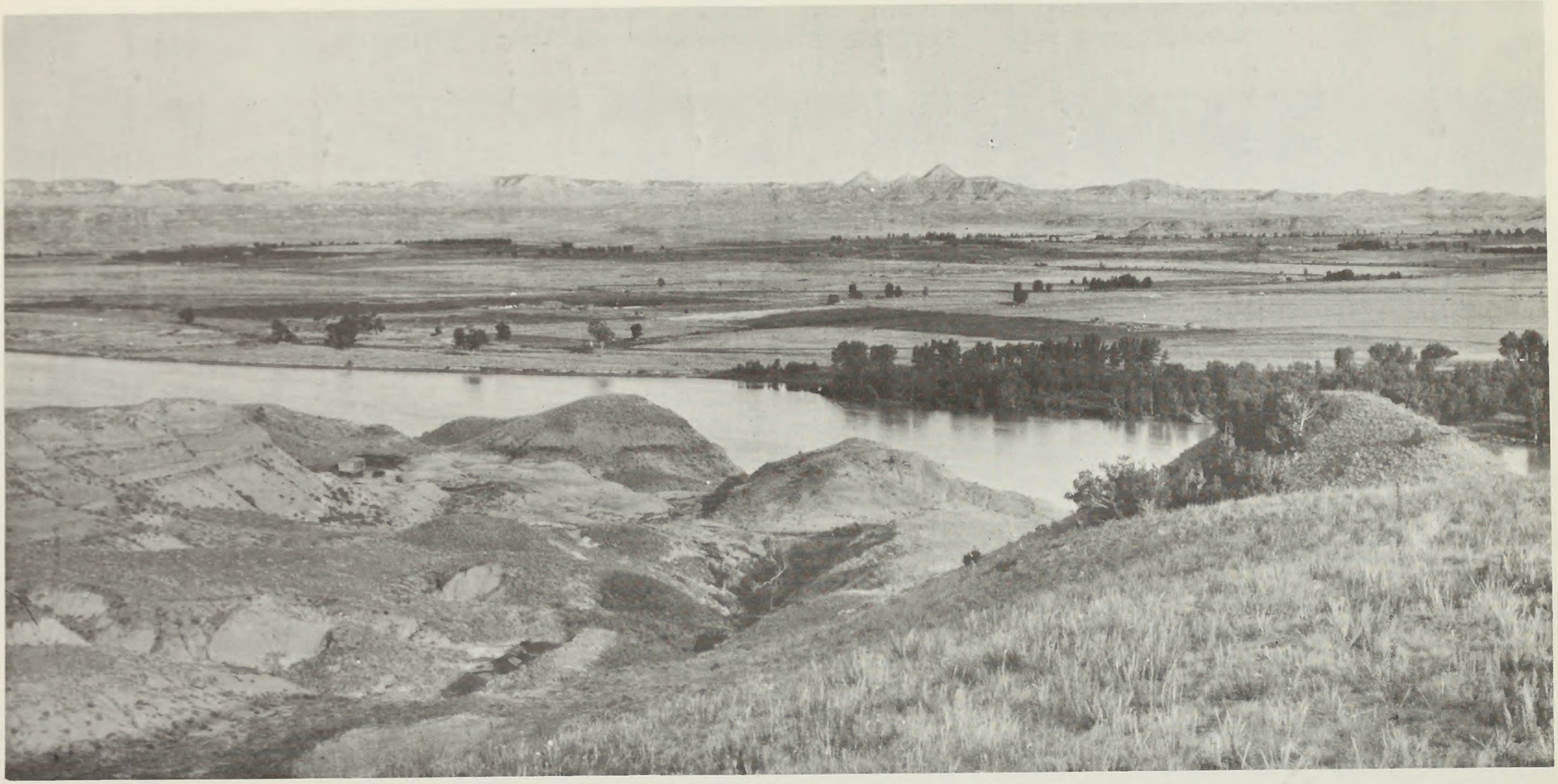


Figure 71 Top photo Collier, 1907. Bottom photo BLM, 1962. Time span 55 years. Yellowstone River Valley at Miles City, Montana. The Tongue River lies two miles upstream. This photo forms a panorama with figure 72 and figure 73. Fewer annuals are seen in 1962. Green sagebrush has been replaced by yucca. Winterfat is present in 1962 but cannot be seen. In general, the vegetation is unchanged. Erosion is mainly geologic with its rate unchanged.



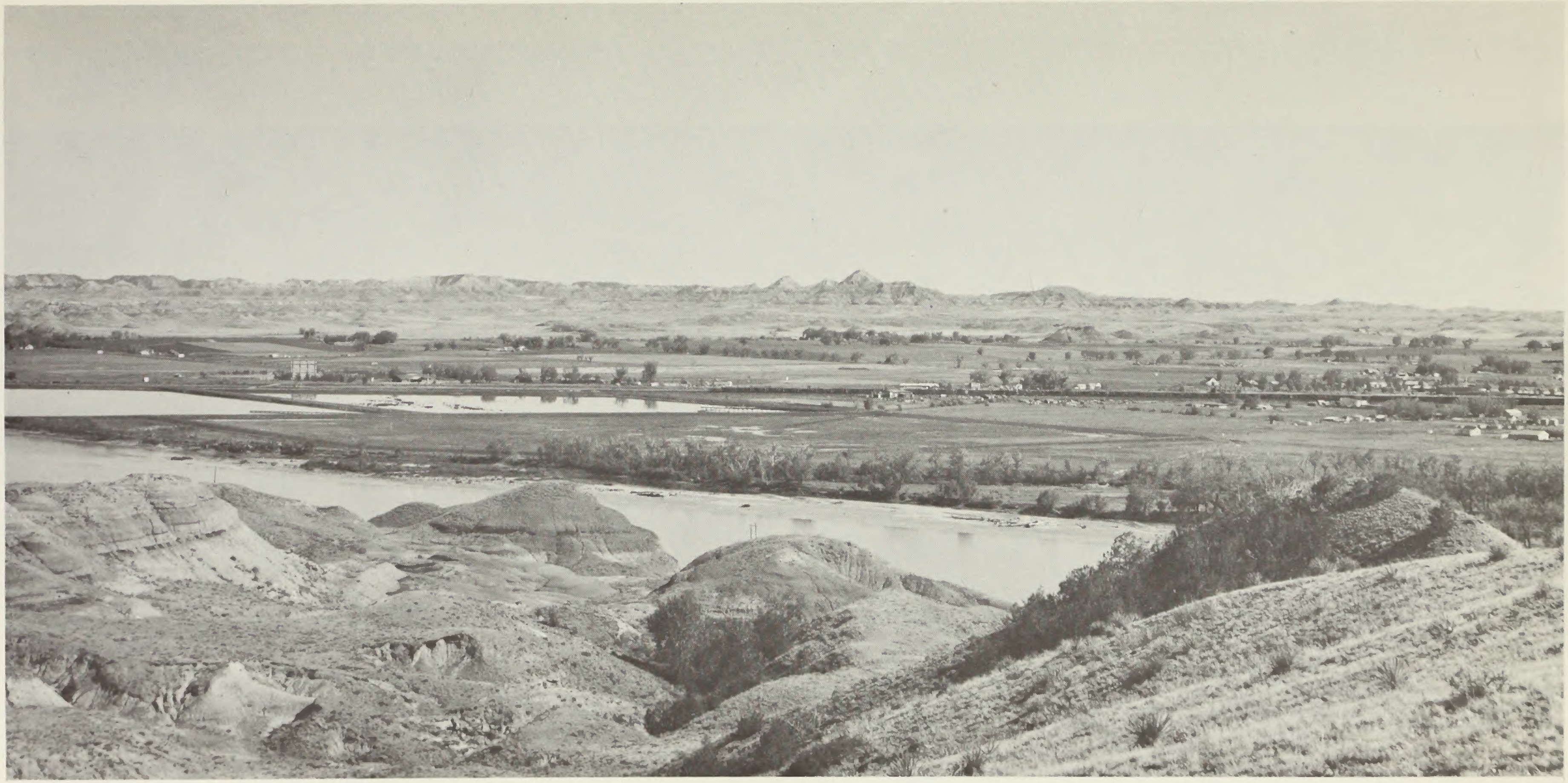
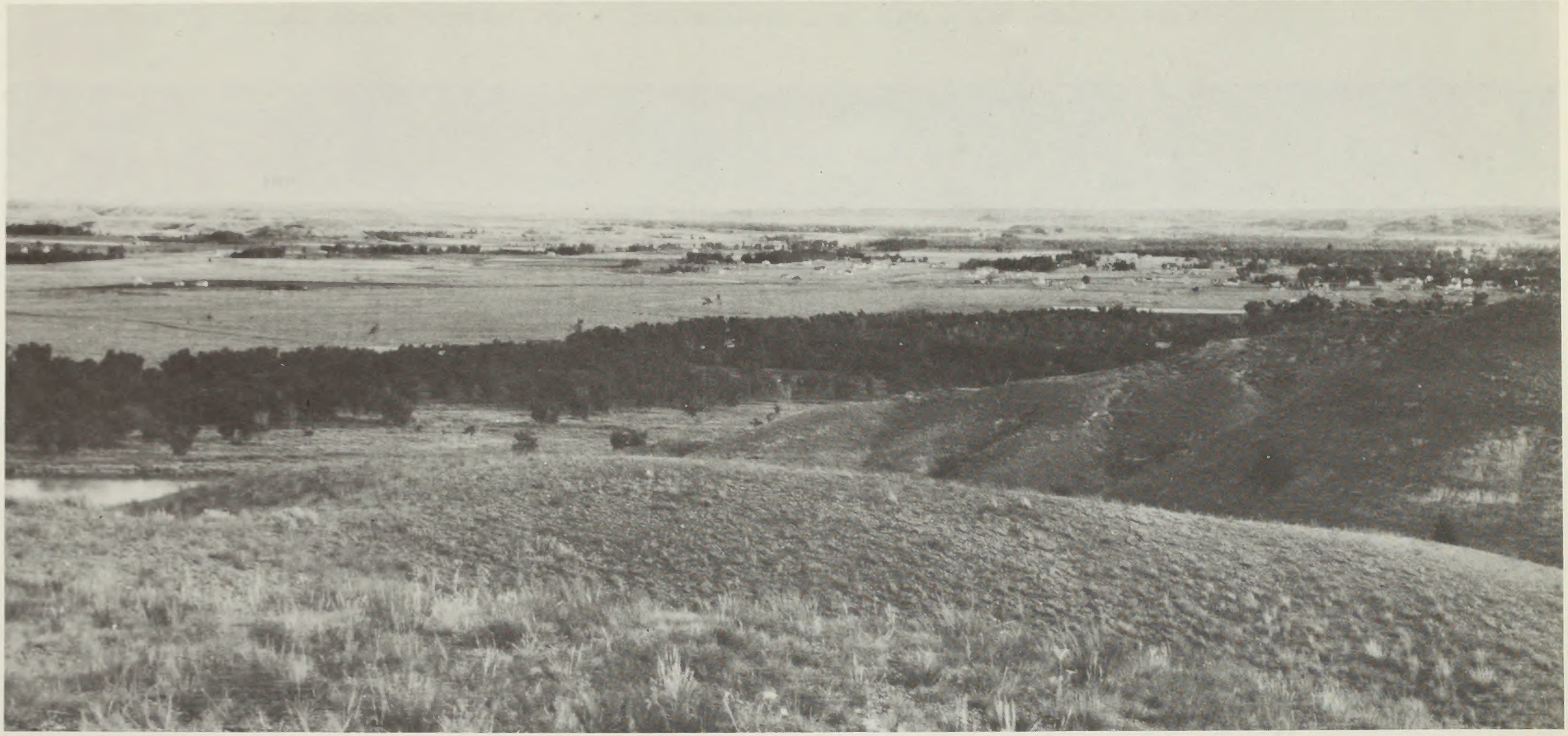


Figure 72 Top photo Collier, 1907. Bottom photo BLM, 1962. Time span 55 years. Yellowstone River Valley at Miles City, Montana. Distant peaks lie just inside the Tongue River. This photo forms a panorama with figures 71 and 73. Clays and gravelly terraces north of Miles City. Gully cuts are unchanged and rate of erosion is extremely slow. Raw soils of 1907 have revegetated. On the gravelly soils, junipers have spread and yucca has invaded, but green sagebrush has disappeared. Needleandthread is the dominant grass. Grazing may have created an impression of a change; change is definite, but the range condition appears the same.



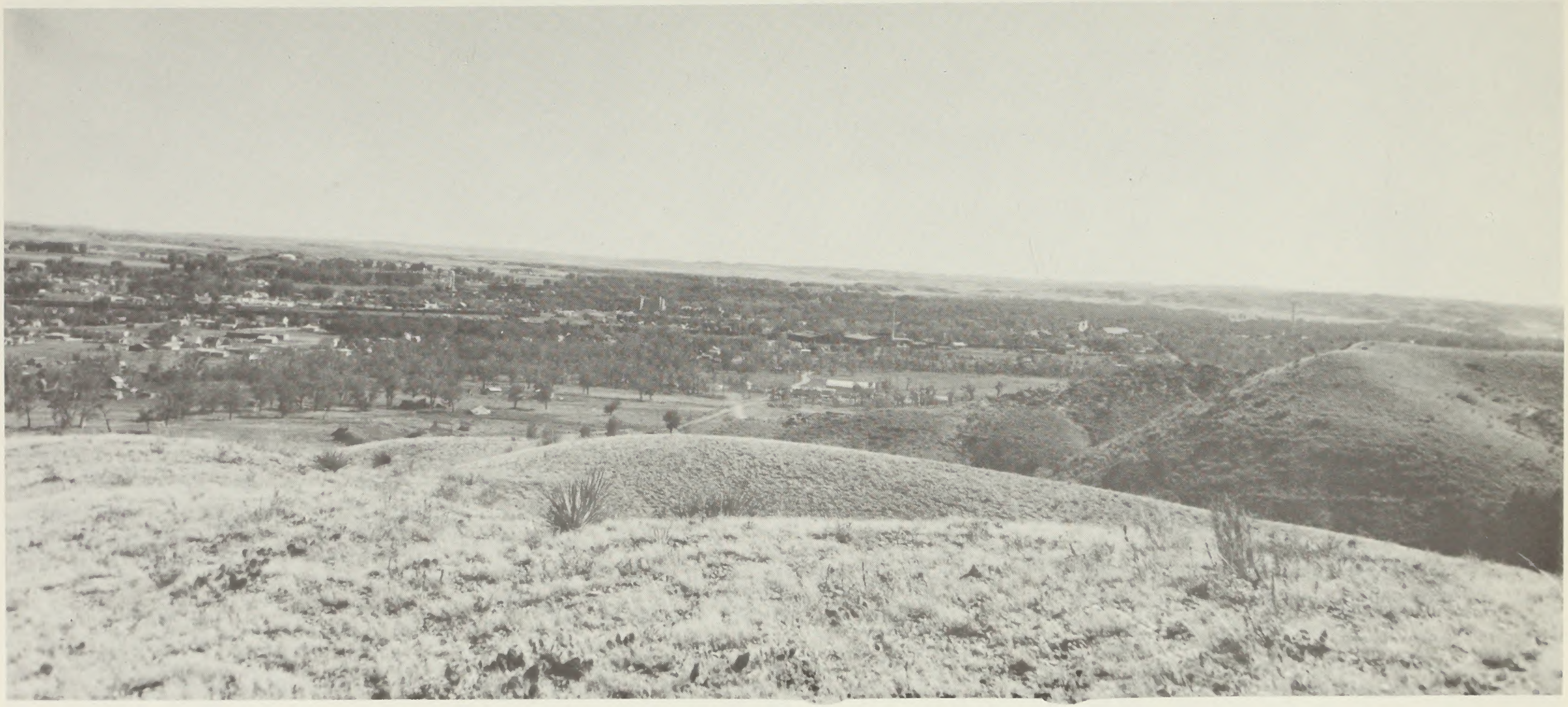
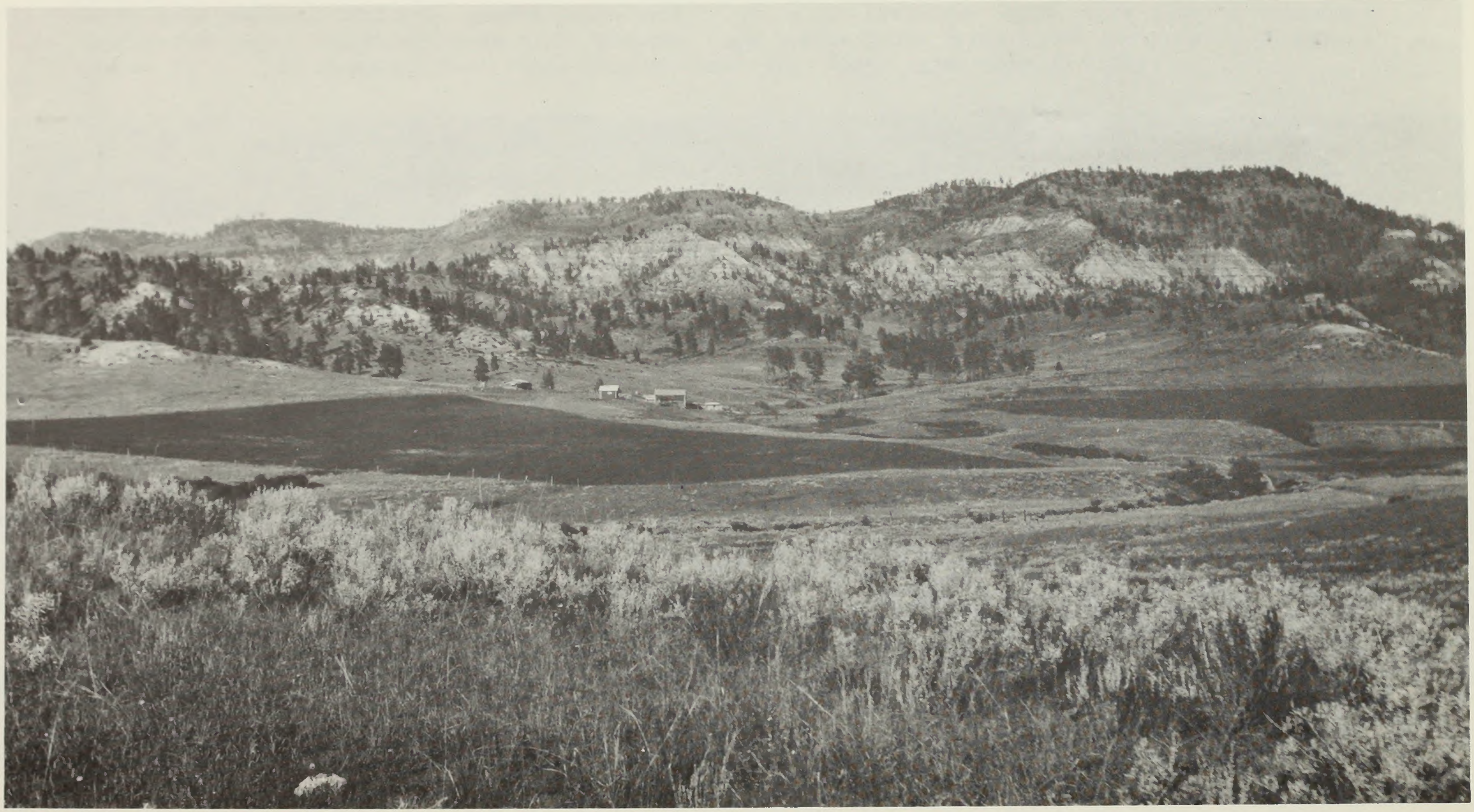


Figure 73 Top photo Collier, 1907. Bottom photo BLM, 1962. Time span 55 years. Yellowstone River Valley at Miles City, Montana. The Tongue River flows along the line of cottonwoods from the left horizon. Tongue River Basin lies in the distance. This photo forms a panorama with figures 71 and 72. Gravelly terraces north of Miles City. Rate of erosion is extremely slow. Raw soils on ridge in 1907 have revegetated (right). On the gravelly soils, yucca has invaded, but green sagebrush has disappeared. Needleandthread is the dominant grass. Grazing may have created an impression of change but the range condition appears the same. (Miles City grew to 7,900 by 1920; population dropped 10 percent in the next ten years, but now is close to 10,000. Cottonwoods dominate the view of the urban area.



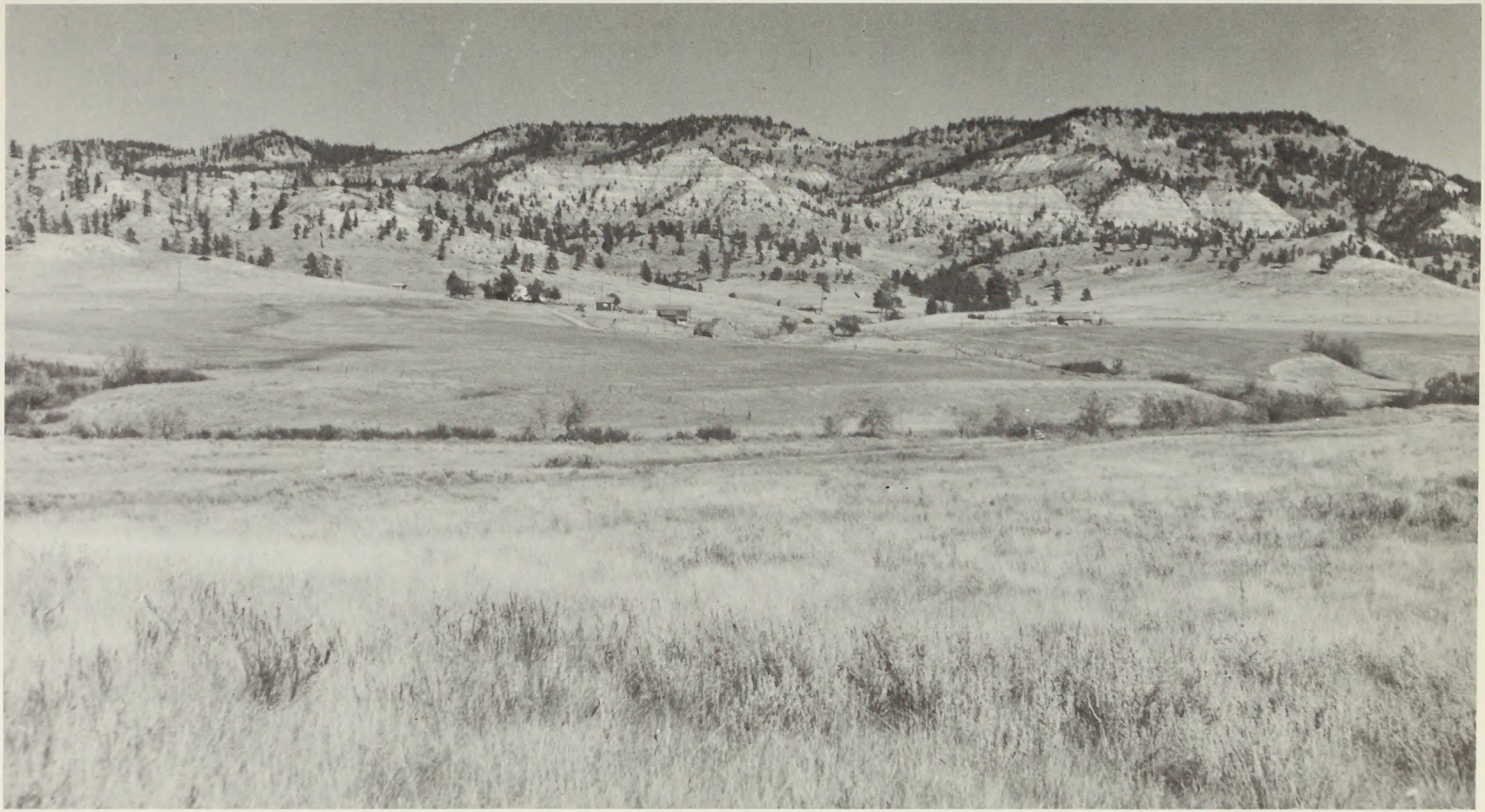
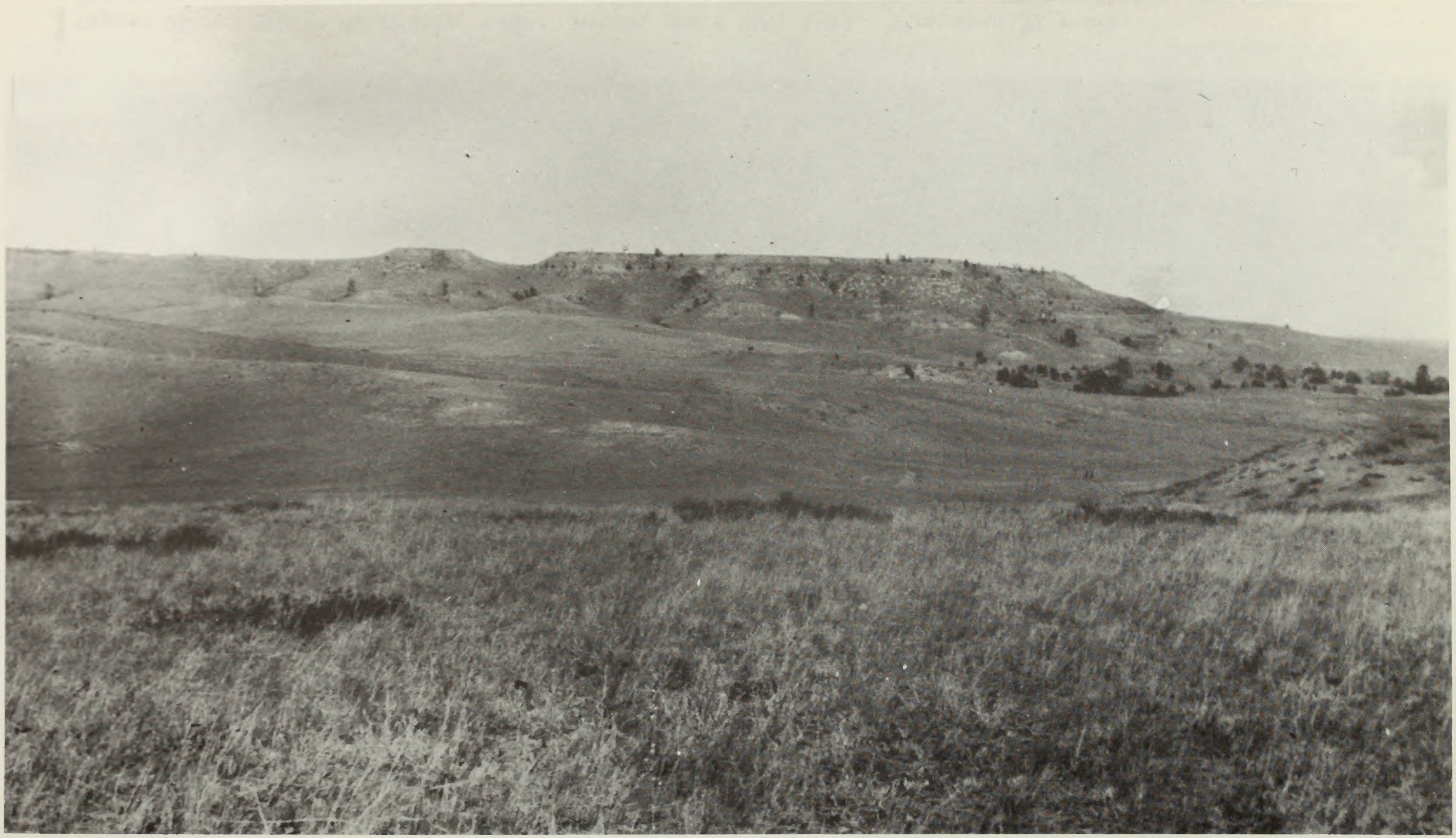


Figure 74 Top photo Dobbin, 1930. Bottom photo BLM, 1963. Time span 33 years.
The number of sagebrush plants has been maintained during the time span between photos, but some individual plants have diminished in vigor and amount of ground cover. Grass has increased in density. Both numbers and size of trees on distant ridges have increased. Timber has been cut from the more accessible ridges close to ranch. Field in bottomland has been removed from cultivation. Game cover and feed greatly increased on the field.



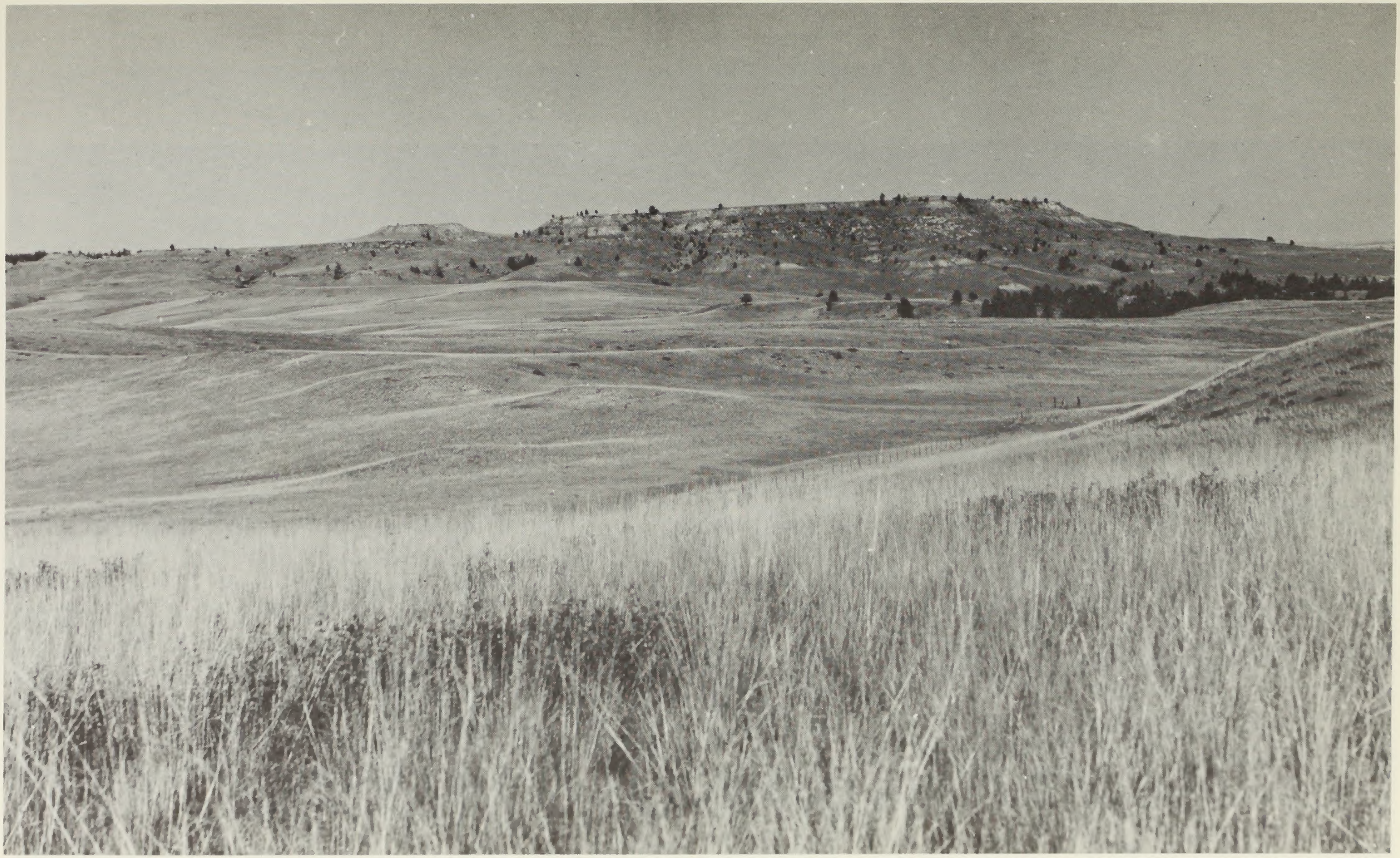
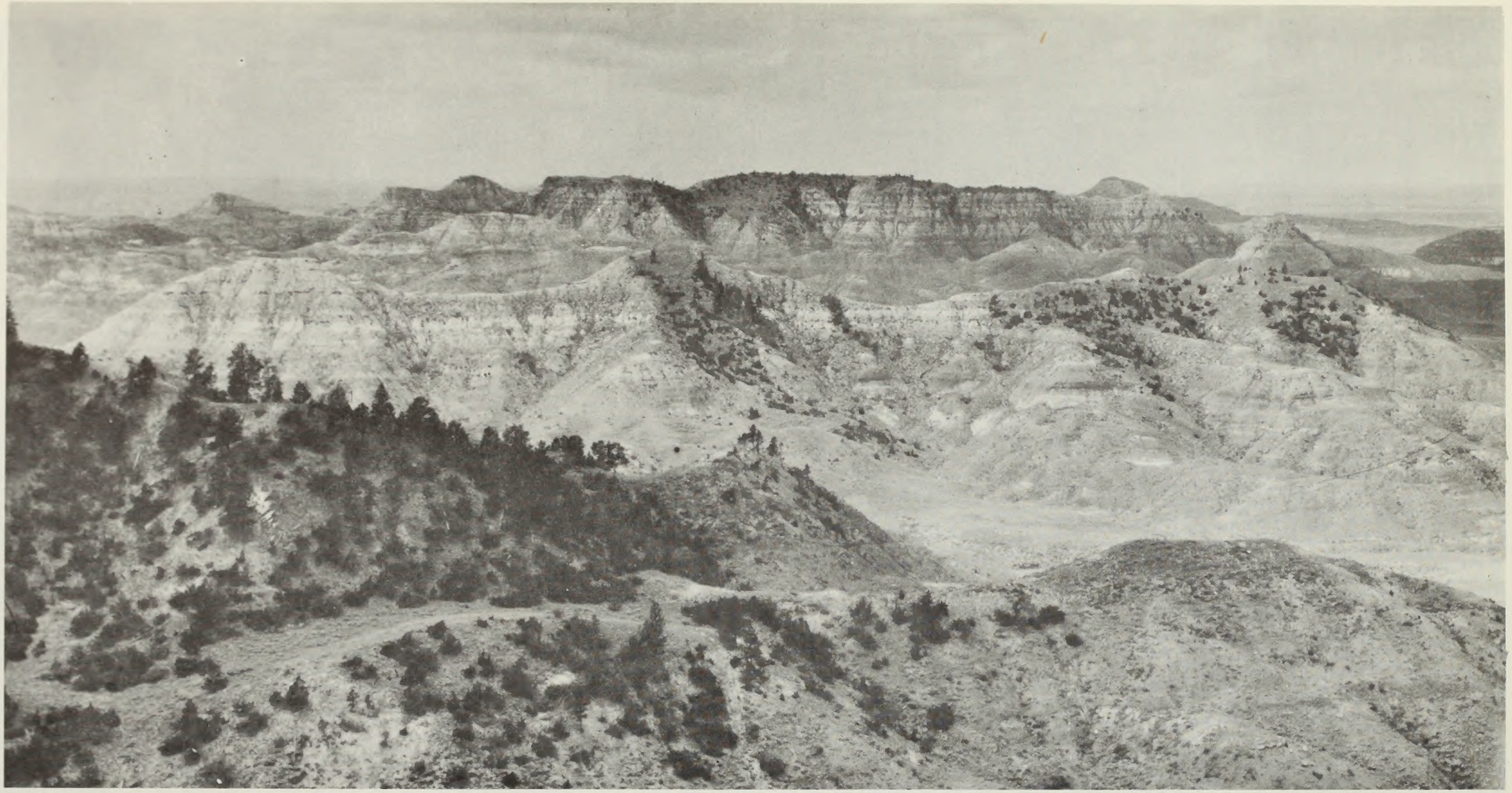


Figure 75 Top photo Baker, 1924. Bottom photo BLM, 1963. Time span 39 years.
The scene is the southern edge of the subbasin near Rosebud Creek. Timber has increased in size and ground cover. Tall grasses now almost hide the (squawbush). Rate of erosion has decreased; the range condition has improved.



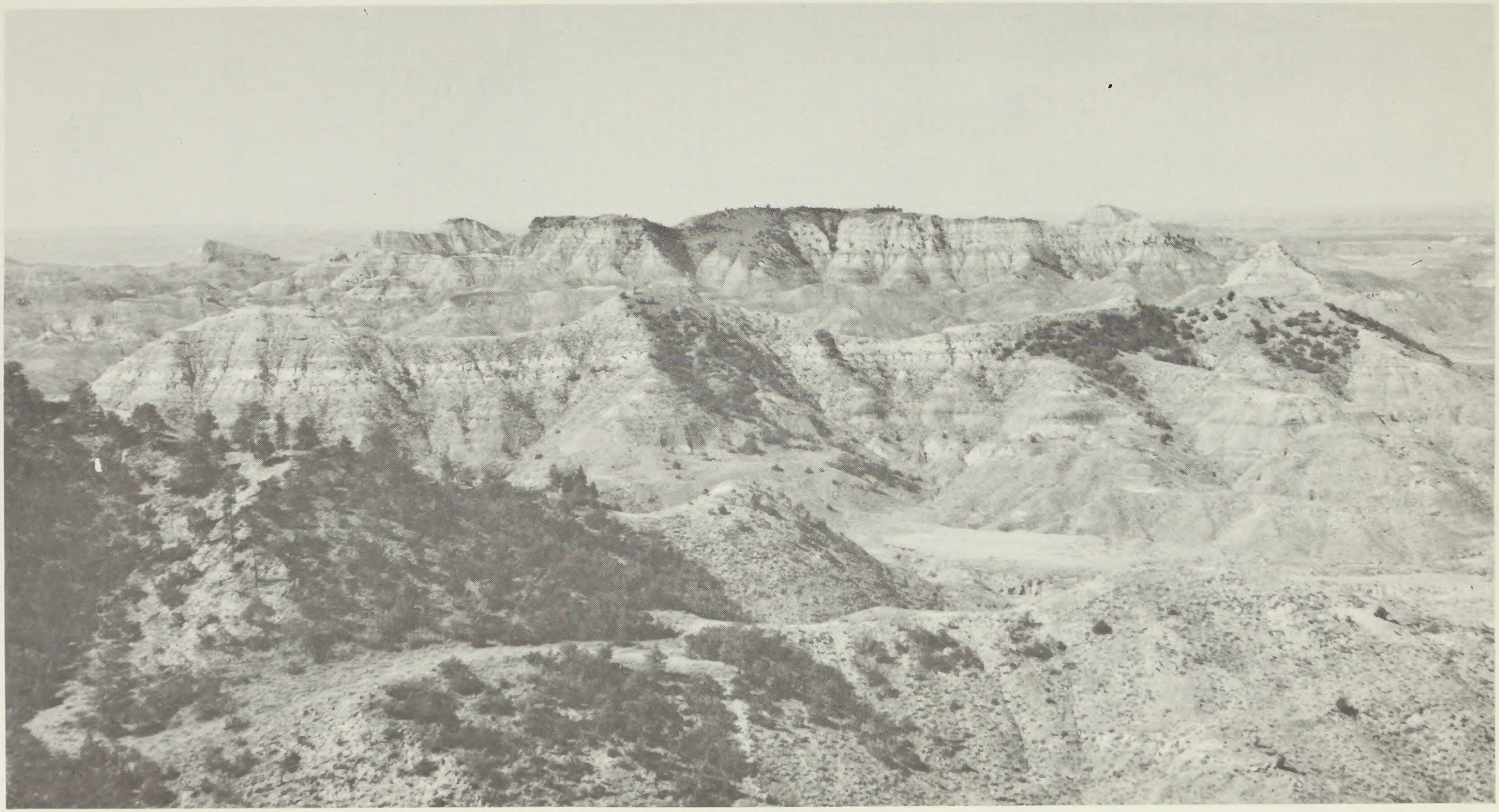
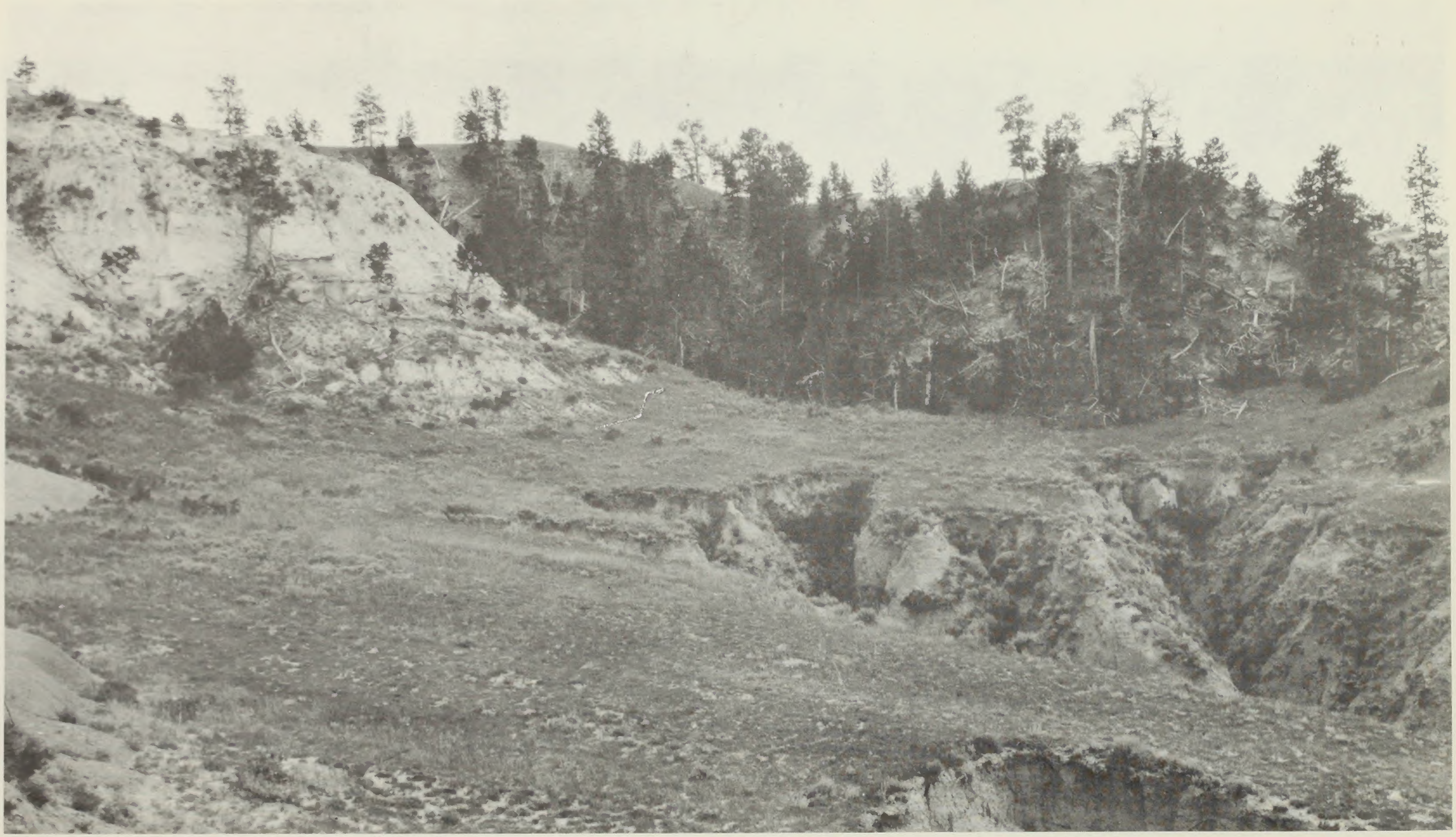


Figure 76 Top photo Collier, 1907. Bottom photo BLM, 1962. Time span 55 years.
Rugged country southeast of Miles City, Montana. Timber has increased in ground cover and density, especially on the hills in the foreground and in middle distance. The large gully, below the canyon in the center, has not extended. Vegetation is vigorous, with adequate ground cover. A favorable trend is apparent in both rate of erosion and condition.



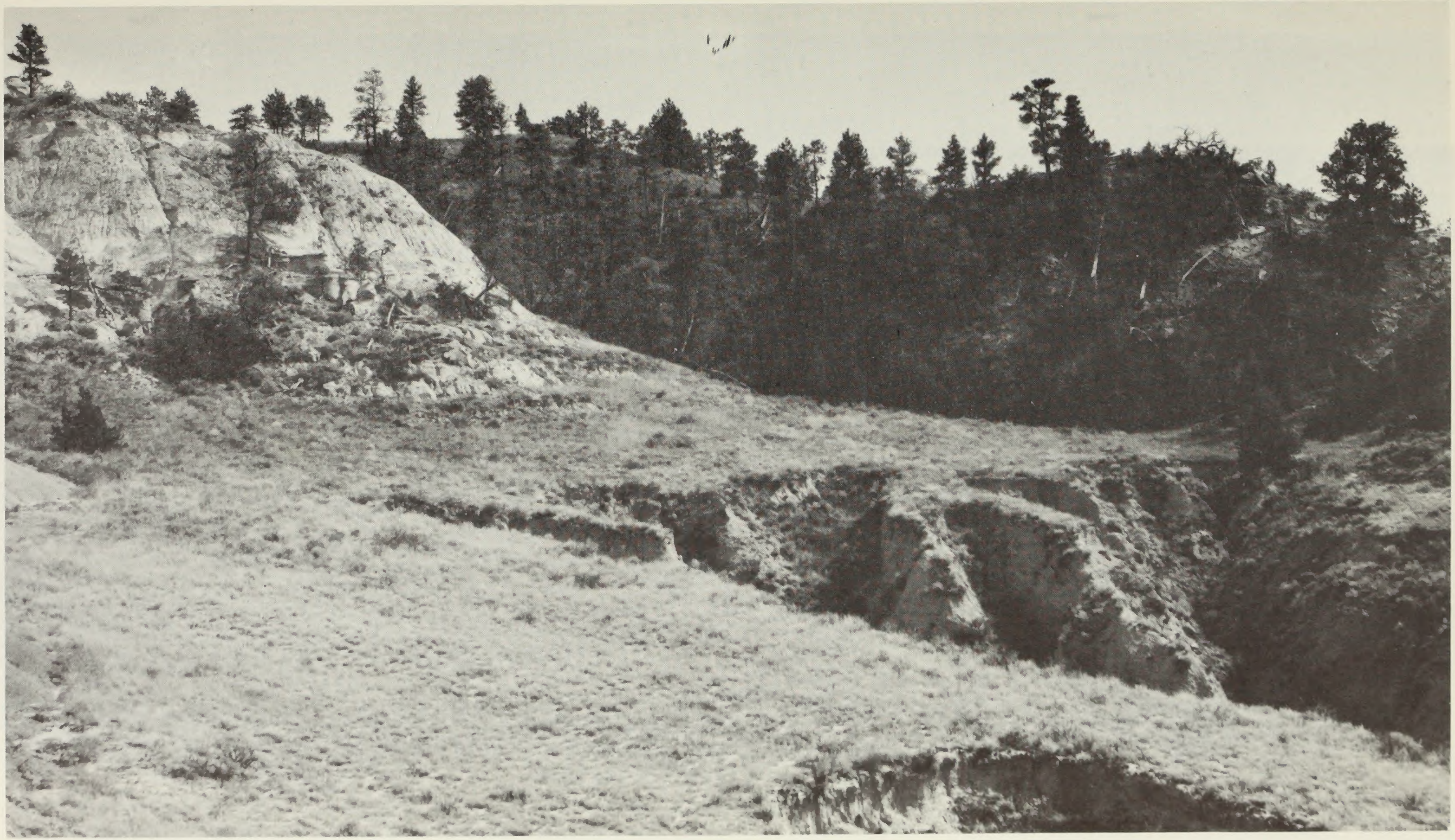
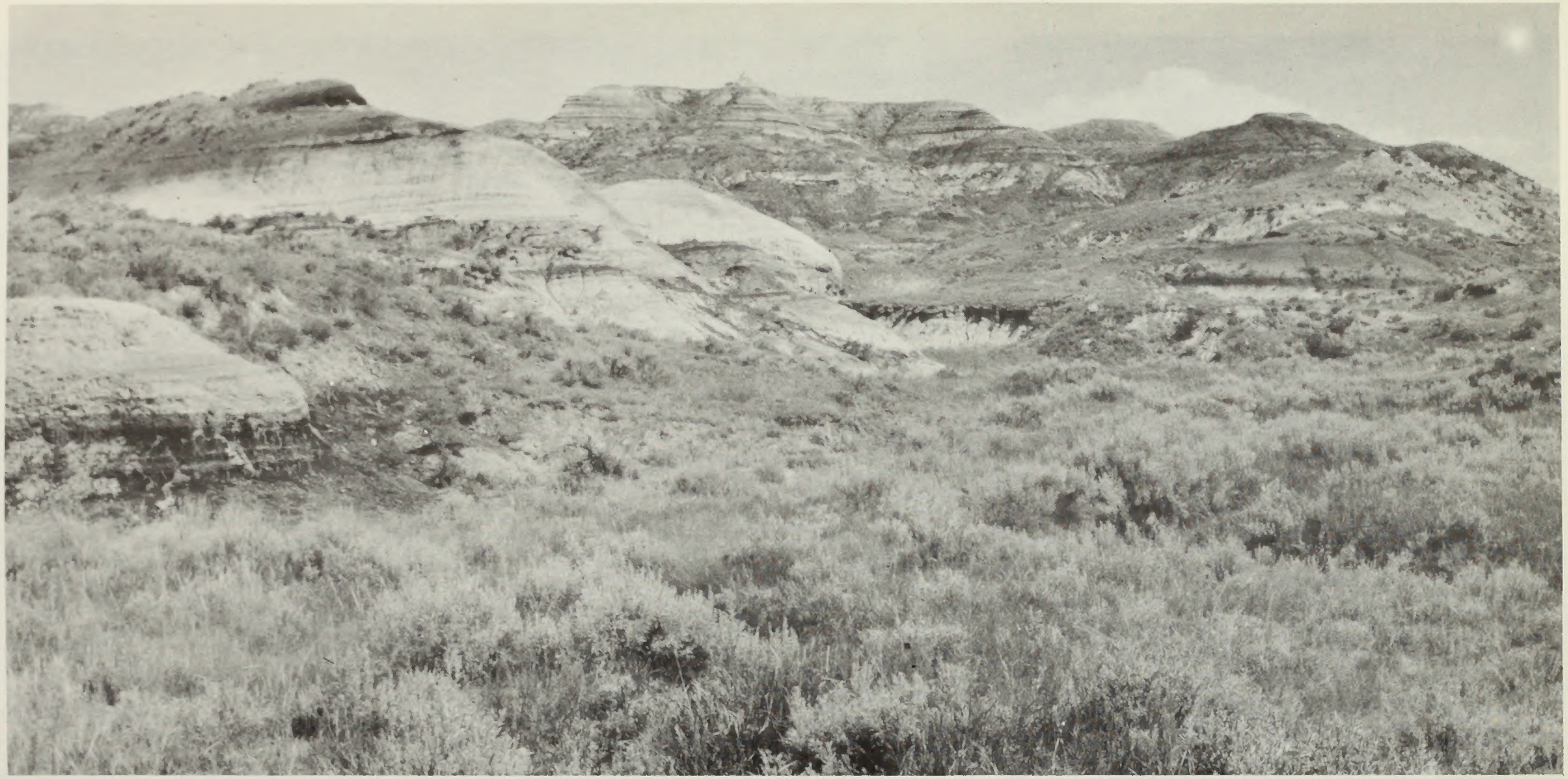


Figure 77 Top photo Collier, circa 1907. Bottom photo BLM, 1962. Time span 60-64 years. Overall improvement in condition. Gully walls have stabilized and ground cover increased, particularly the grasses in foreground. Timber on the ridge has increased in size and number of plants. Sixty years is the realistic interval between comparisons. This photo is on the southeast border of the Middle Yellowstone Area.



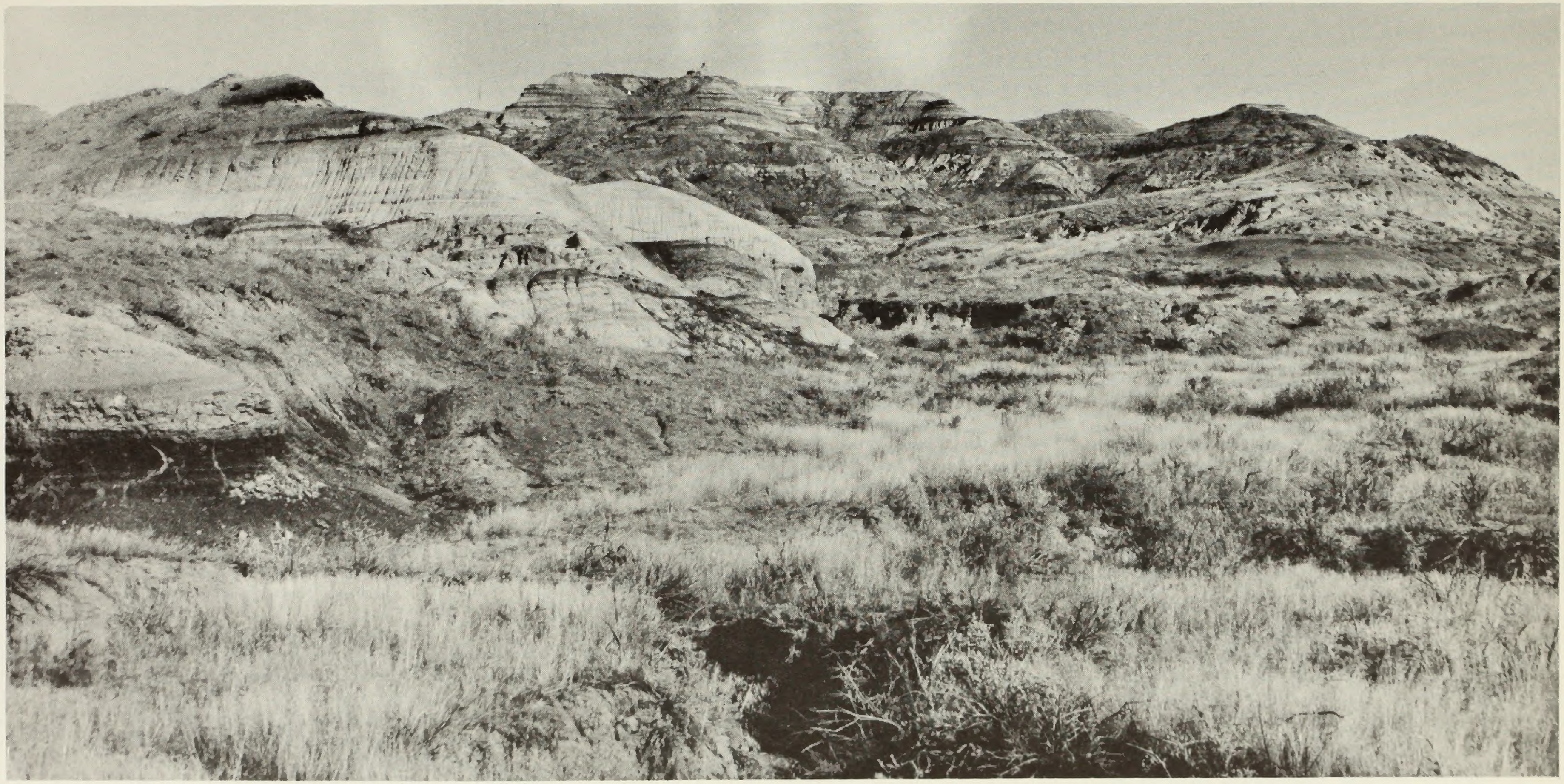


Figure 78 Top photo Collier, 1907. Bottom photo BLM, 1962. Time span 55 years. Badlands on the lower Tongue River drainage southeast of Miles City, Montana are part of the Middle Yellowstone Area. 1962 photograph taken about 12 feet from the original. In the foreground silver sagebrush has disappeared, western wheatgrass has decreased to be replaced in part by annuals. The slopes on the left had dead shrubs in 1962, ground cover was greatly decreased and erosion increased. Geologic erosion aggravates the problem of accelerated erosion and reduced water quality.

FACTORS IN SOIL DEVELOPMENT
MIDDLE YELLOWSTONE AREA

Climate cool, semi-arid to subhumid, 12 to 19 inch precipitation
Mean average temperature 45° F.

Topography, age and parent materials override effects of climate or vegetation.

Climate, vegetation, topography, age, parent material affect soil development.

AZONAL SOILS (81% of subbasin)

Parent material is so new that insufficient time has passed for soil profile development, or -- erosion is removing soil as fast as it forms, or -- erosion is depositing new material too rapidly for development of a soil profile.

Lithosols (50% of subbasin)
Have no clearly developed soil morphology. Mostly rock fragments from consolidated rocks which are imperfectly weathered. Found on steeply sloping land.

Regosols (25% of subbasin)
Soils developed from deep soft deposits (unconsolidated rock) with few if any clearly expressed soil profile. Usually on steep slopes on recent sand dunes, clays, shales and loesses.

Alluvials (6% of subbasin)
Soils developed from water-transported recently deposited fine materials (clay, sand, silt). Often intermixed along Yellowstone River with gravel deposits. Soil-forming processes modify only weakly, or not at all, the original material. Much of the irrigated farming in the subbasin is on these soils.

ZONAL SOILS (8% of subbasin)

Soils fully developed through interaction of soils, climate and vegetation. Mature soil profile will change no further if these two factors remain stable.

Browns (8% of subbasin)
Soils having a brown surface horizon that grades into lighter-colored soil and finally into a layer of carbonate accumulation 12 to 15 inches deep. Limited occurence in subbasin; most of its dryland farming is on these soils which have developed in the 12 to 14 inch annual rainfall belt.

Chestnuts (Minor occurence)
Soils having a dark brown surface horizon which grades below into lighter-colored soil and finally into a horizon of carbonate accumulation. Highly fertile. Severely limited in occurence in the basin to higher elevations with more moisture.

INTRAZONAL SOILS (11% of subbasin)

Soils with more or less well-developed soil characteristics that evolve because of the dominating influence of some local factor of relief, parent material, or age overriding the effect of the climate and vegetation.

Grumosols (10% of subbasin)
Very heavy soils derived from clays and shales. High percentage of montmorillonitic clays. No horizons, characteristic churning with alternate drying and wetting.

Solonchak (1% of subbasin)
Soils with a high concentration of soluble salt; usually light-colored; without characteristic structural form; developed under salt-loving grass or shrubs.

Soloth (Minor occurence)
Soils with a thin surface layer of brown, friable soil over a gray leached horizon resting on a brown or dark brown horizon. Developed under shrubs, grasses.

Solonetz (Minor occurence)
Soils with a variable surface horizon of loose friable soil underlain by dark, hard soil, ordinarily with columnar structure; usually highly alkaline; developed under grass or shrub.

EROSION - PIPING

A form of erosion often overlooked but inherent to the entire Missouri River Basin is that of "piping". Piping is worldwide in occurrence especially in dry lands. It takes a destructive form with steep-sided gullies and lays waste large areas of soil. Burr, (1942), in a preliminary investigation on piping found as much as 20 percent of the area of livestock ranches, immediately adjacent to the Canadian River in Texas, were eroded solely by piping. The loss in productivity is drastic; many piped areas become barren, picturesque waste.

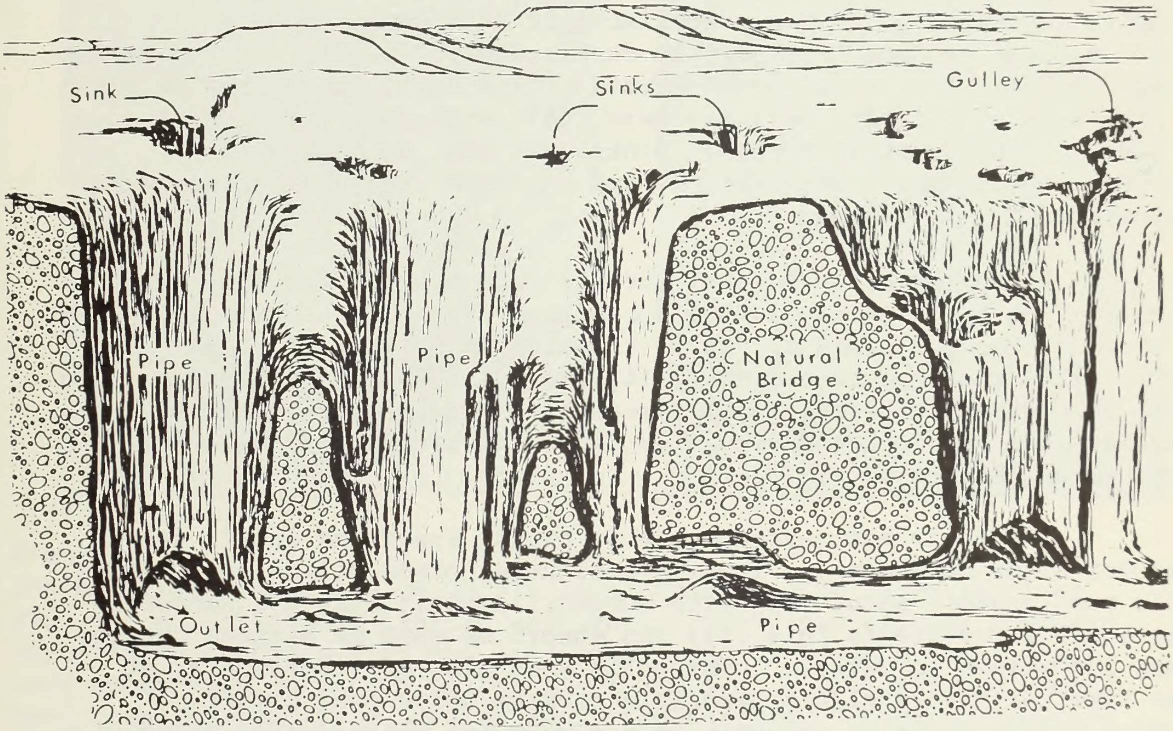


Figure 79 A diagram of piping, a form of erosion found in the Missouri River Basin. Vertical pipes or "sinks" outlet through horizontal pipes developed on an impermeable layer, into a gully, itself formerly a horizontal pipe. The gully developed by collapse of natural bridges. Topography of this nature is termed a "pseudokarst".

The worst problem is the difficulty of control. Figure 80. Other forms of erosion are normally controlled by vegetation or by surface structures designed to slow the transportation of soil particles. Water erosion is combated by terraces, water spreading and check dams; wind erosion is controlled by plant barriers and occasionally artificial barriers. With piping, which depends solely on water, a structure such as a terrace or dam will only aggravate the problem and have disastrous results.

Parker and Jenne[1] state: "...Piping is the development of subsurface drainage systems in earth materials, to a depth no greater than the nearby base level of drainage. It results in a surface expression much like miniature solution depressions in limestone or dolomite terrains..." This resemblance is in appearance only. Solution plays no important part in development of piping. The erosion forms resulting are termed pseudokarst. (True karst topography is found in limestone or dolomite regions where, unlike piping, solution of rock in water is the creative force. Sinks, caverns, natural bridges, subterranean streams, sheer cliffs, and a general lack of surface water characterize karst terrain.)

As has been stated, all the Missouri River subbasins, without exception, have the prerequisites for piping, "...Sufficient water either to cause drainage through cracks or to saturate a layer of higher permeability than the layers below it, hydraulic head sufficient to move water through a subsurface rock, presence of a permeable (or deeply cracked) soil or bedrock above gully floor level, and an outlet for flow..." [2] Figure 80.

The soils most susceptible to piping are found in all the Missouri River subbasins. These are alluvial often saline soils. The soils must contain about one-fifth montmorillonitic clay (a sandwich-like ionic structure in this clay can absorb as much as sixteen hundred times its weight in water). The soils must also dry thoroughly, at some time, or have a highly permeable stratum below the surface. Another prerequisite is presence of a sodium ion which causes dispersion of the soil structure (locally dry buried soils, such as loess deposits, may also pipe when wetted in some unusual circumstance). Silts and clays are the two main soils most susceptible to piping. Conditions favoring piping are so widespread that it is a serious problem in management of range lands and especially in the establishment of artificial structures such as dams or roads.

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[1] Structural Failure of Western U. S. Highways Caused by Piping, U. S. Geological Survey, January 18, 1967, Parker, G. G., and Jenne, E. A.

[2] Ibid.

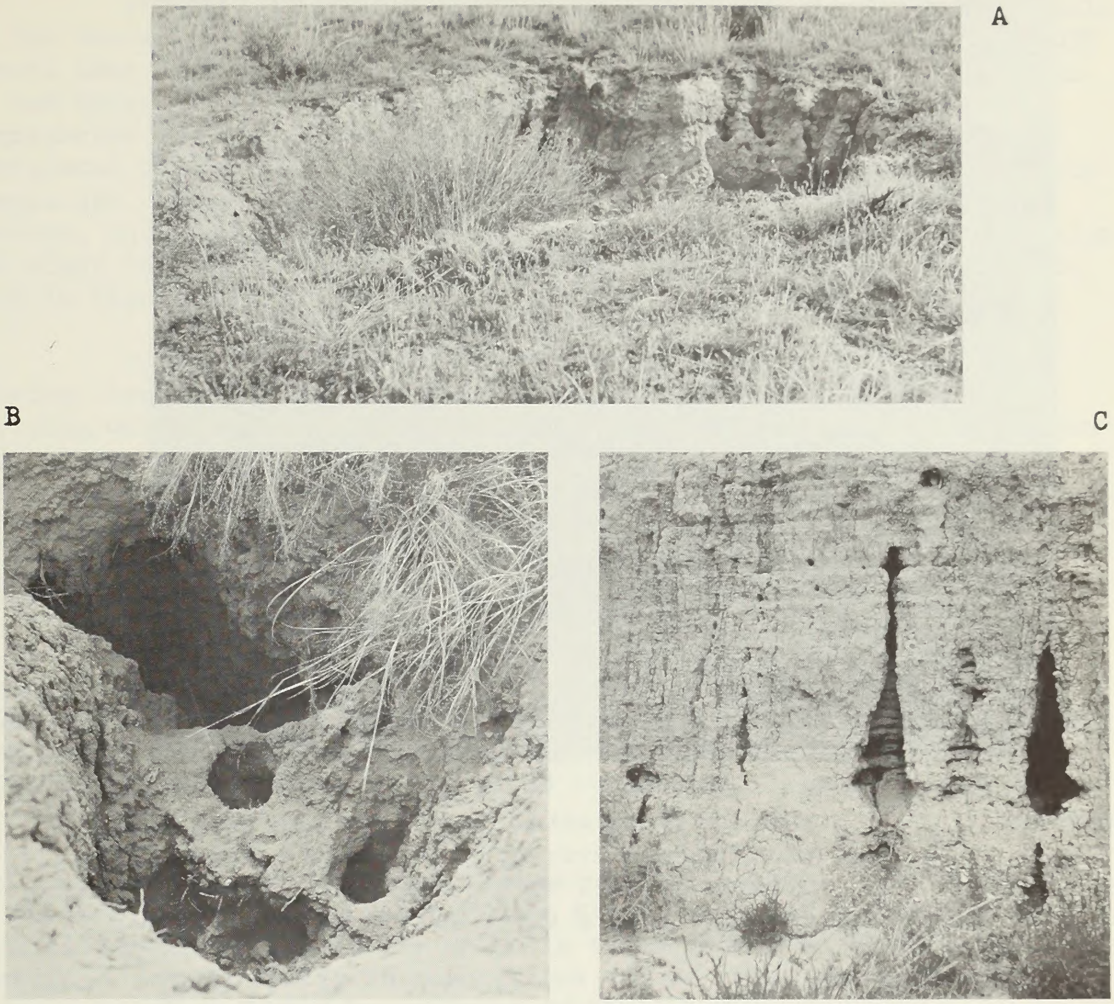


Figure 80
Piping often originates on fairly level ground. The large vertical pipe in "A" could have started when water runoff percolating downward encountered a long buried and dessicated lens of loess or silt, that upon saturation collapsed into a smaller space. The collapse would have been followed by a subsidence of the surface. Looking downward into a large pipe "B" shows a subsidence in which vertical pipes developed later.

Dry soils susceptible to piping usually develop wide deep cracks that extend downward several feet. Piping can start in these cracks even on steeply sloping soils. Surface runoff pouring down the crack enlarges it by cutting until a layer is reached where horizontal pipes must develop, then the water usually outlets into an arroyo or gully, such as that in "C", where the stream has now cut away its channel wall to reveal cross sections of vertical pipes.

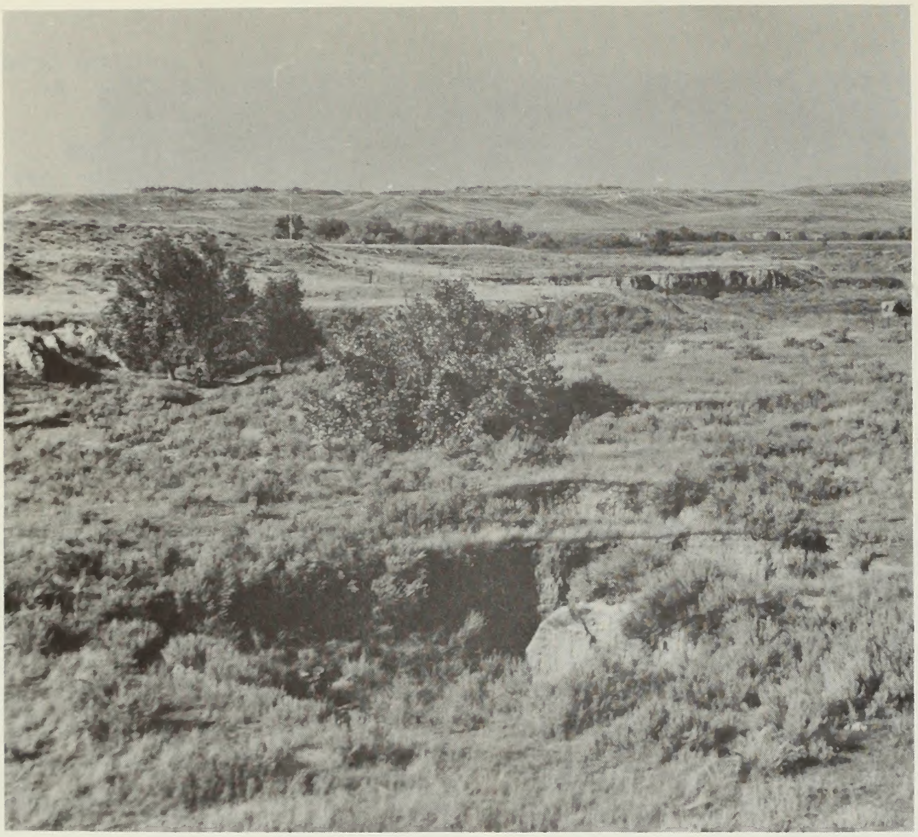


Figure 81

This gully is actually a collapsed horizontal pipe bridged over by a series of broad natural bridges of soil still in place. Eventually these collapse into a sheer walled gully.

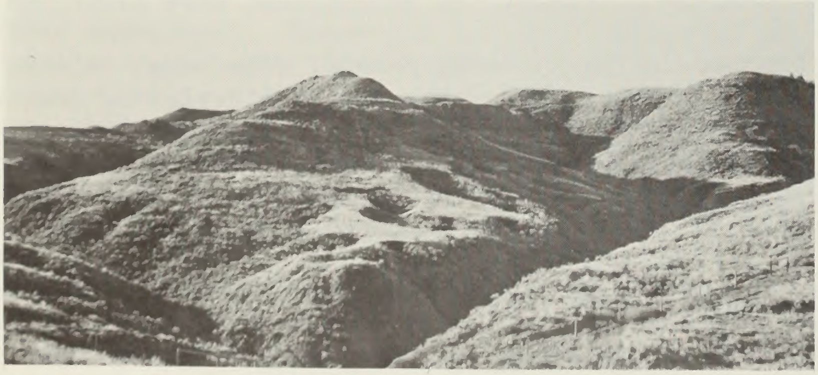


Figure 82

Sinks join together in gullies in mid-distance. These sinks were formed by collapse and subsidence of subsurface pipes which riddle the soil.

The most common type of piping encountered in the Tongue basin is one where cracks are formed by a soil drying and shrinking. Runoff enters this crack at the soil surface and moves down eroding the walls. If the hydrologic gradient is steep a fine-grained sediment may be transported in suspension along this certical crack, then through a horizontal crack into an outlet on the side slope of an arroyo or gully. Cracks are the usual starting point for a pipe; sediment deposits, however, such as loess below the surface, may be moistened to saturation and slump to start infiltration into a small sink. The start is like that in figure 80.

Construction such as a dam or wall confines water behind a barrier, creating hydraulic heads that can start a subsurface flow carrying water-saturated earth materials. This discharges on the down side of the barrier. The Bureau of Land Management and other land management groups encounter this entrainment type of piping in construction of stock or erosion control dams on soils or base material susceptible to piping. Once piping starts the overlying structure will often collapse.

A third type of piping is similar to the entrainment type. In this a hydraulic head transports clay and silt and sand through a stratum with sufficient velocity to maintain its identity and discharge them into a gully. These gullies are formed and enlarged through collapse and coalescence of the piped structures, figures 81 and 82.

Piping can form extensive networks of caves. In badlands on the headwaters of the North Platte River, pipes in a clay derived from saline shales extend for miles in tubes from 8 to 12 feet in diameter. These ramify throughout the entire area, and spectacular scenery is often formed by collapse of the tubes.

FIGURE 83 PLANT FREQUENCIES (NUMBER OF TIMES A PLANT WAS LISTED AS PRESENT IN ANY QUANTITY IN 754 WRITEUPS)

Continued on next page.

COMMON NAME	SCIENTIFIC NAME	NO. OF OCCURRENCES
SANDBERG BLUEGRASS	POA SECUNDA	696
BLUE GRAMA	BOUTELOUA GRACILIS	674
WESTERN OR BLUESTEM WHEATGRASS	AGROPYRON SMITHI	665
BIG SAGEBRUSH	ARTEMISIA TRIDENTATA	633
PRICKLYPEAR CACTUS	(2) OPUNTIA SPP.	556
NEEDLEANDTHREAD	STIPA COMATA	545
BLUEBUNCH WHEATGRASS	AGROPYRON SPICATUM	484
THREADLEAF SEDGE	CAREX FILIFOLIA	414
BROOM SNAKEWEED	GUTIERREZIA SAROTHRAE	382
FRINGED SAGEBRUSH	ARTEMISIA FRIGIDA	378
PRAIRIE SANDREED	CALAMOVILFA LONGIFOLIA	363
BLACK GREASEWOOD	SARCOBATUS VERMICULATUS	360
PHLOX	PHLOX SPP.	359
SILVER SAGEBRUSH	ARTEMISIA CANA	320
ERIOGONUM	ERIOGONUM SPP.	300
INDIAN RICEGRASS	ORYZOPSIS HYMENOIDES	268
JUNEGRASS	KOELERIA CRISTATA	268
CHEATGRASS (DOWNY BROME)	BROMUS TECTORUM	254
GREEN NEEDLEGRASS	STIPA VIRIDULA	249
LITTLE BLUESTEM	ANDROPOGON SCOPARIUS	232
WOOLLY INDIANWHEAT	PLANTAGO PURSHI	230
PLAINS OR STONYHILLS MUHLY	MUHLENBERGIA CUSPIDATA	229
GARDNER OR NUTTALLS SALTBUSH	ATRIPLEX GARDNERI (A. NUTTALLI)	225
ALKALI SACATON	SPOROBOLUS AIROIDES	220
DESERT SALTGRASS	DISTICHLIS STRICTA	217
SQUAWBUSH	RHUS TRILOBATA	216
SMALL SOAPWEED	YUCCA GLAUCA	210
SCARLET GLOBEMALLOW	SPHAERALCEA COCCINEA	196

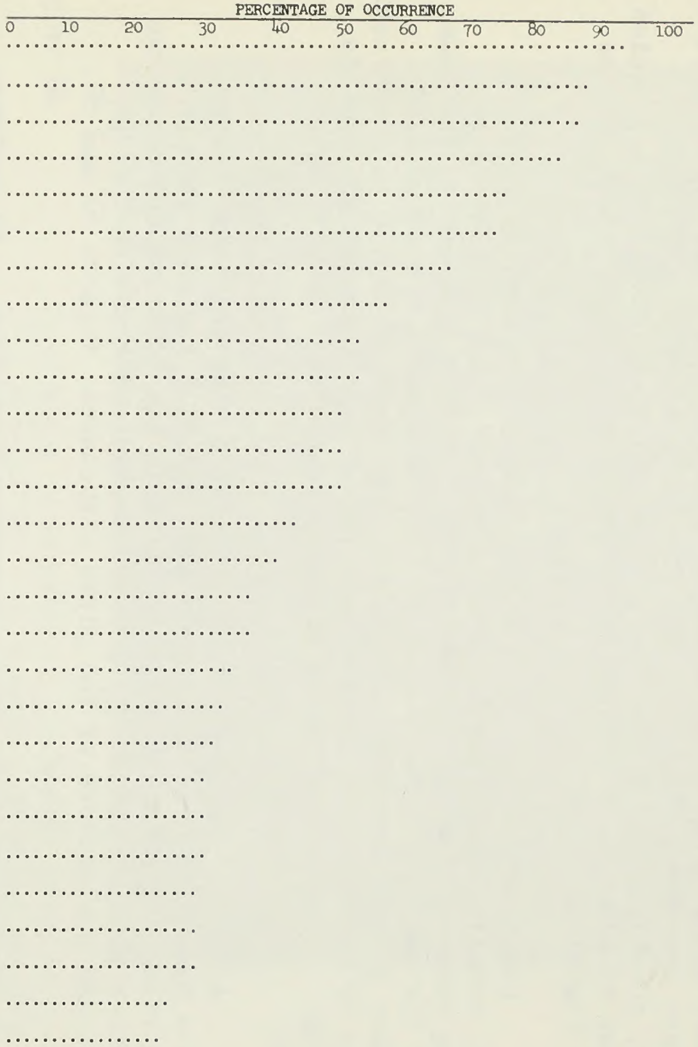


FIGURE 83

COMMON NAME	SCIENTIFIC NAME	NO. OF OCCURRENCES	PERCENTAGE OF OCCURRENCE 0 10 20 30 40 50 60 70 80 90 100
SIXWEEKS FESCUE	FESTUCA OCTOFLORA	188	....
SQUIRRELTAIL	SITANION HYSTRIX	178	....
SHADSCALE	ATRIPLEX CONFERTIFOLIA	174	....
PONDEROSA PINE	PINUS PONDEROSA	165	....
WINTERFAT	EUROTIA LANATA	160	....
JAPANESE BROME	BROMUS JAPONICUS	153	....
ASTER	ASTER SPP.	152	....
GUMWEED	GRINDELIA SQUARROSA	147	....
SIDEOATS GRAMA	BOUTELOUA CURTIPENDULA	136	....
JUNIPER	JUNIPERUS SPP.	133	....
PRAIRIECLOVER	PETALOSTEMON SPP.	126	....
WHEATGRASS	AGROPYRON SPP.	112	....
SUNFLOWER	HELIANTHUS ANNUUS	105	....
SEDGE	CAREX SPP.	105	....
ROSE	ROSA SPP.	94	....
RED THREEAWN	ARISTIDA LONGISETA	86	....
SAND DROPSEED	SPOROBOLUS CRYPTANDRUS	86	....
LITTLE BARLEY	HORDEUM PUSILLUM	71	......
MUSTARD	CRUCIFERACEAE	71	......
LOCO	ASTRAGALUS SPP.	68	......
DOTTED GAYFEATHER	LIATRIS PUNCTATA	59	.....
TUMBLEGRASS	SCHEDONNARDUS PANICULATUS	57	.....
WESTERN YARROW	ACHILLEA LANULOSA	56	....
RUSSIANTHISTLE	SALSOLA KALI TENUIFOLIA	55	....
MONOLEPIS	MONOLEPIS NUTTALLIANA	50	....
THISTLE	CIRSIUM SPP.	50	....
FOXTAIL BARLEY	HORDEUM JUBATUM	48	...
DEATHCAMAS	ZIGADENUS SPP.	47	...
SCURFPEA	PSORALEA SPP.	46	...

FIGURE 83

COMMON NAME	SCIENTIFIC NAME	NO. OF OCCURRENCES	PERCENTAGE OF OCCURRENCE 0 10 20 30 40 50 60 70 80 90 100
PUSSYTOES	ANTENNARIA SPP.	44	....
SNOWBERRY	SYMPHORICARPOS SPP.	43	....
GREENMOLLY	KOCHIA AMERICANA	43	....
NEEDLELEAF SEDGE	CAREX ELEOCHARIS	40	...
FALSETARRAGON	ARTEMISIA DRACUNCULOIDES	40	...
SAGEBRUSH	ARTEMISIA SPP.	38	...
BLACKSAMSON	ECHINACEA ANGUSTIFOLIA	38	...
OYSTERPLANT	TRAGOPOGON PORRIFOLIUS	35	...
LUPINE	LUPINUS SPP.	34	..
HAIRY GOLDASTER	CHRYSOPSIS VILLOSA	33	..
SALTBUSH	ATRIPLEX SPP.	29	..
LICORICE	GLYCYRRHIZA LEPIDOTA	27	..
YELLOW SWEETCLOVER	MELILOTUS OFFICINALIS	26	3.0%
VETCH	VICIA SPP.	22	.
PLAINS COTTONWOOD	POPULUS SARGENTI	22	.
BISCUITROOT	LOMATIUM SPP.	20	.
DANDELION	TARAXACUM OFFICINALE	19	2.0%
IDAHO FESCUE	FESTUCA IDAHOENSIS	18	.
BUFFALOGRASS	BUCHLOE DACTYLOIDES	17	.
GOLDENWEED	HAPLOPAPPUS SPP.	15	.
HELIANTHELLA	HELIANTHELLA SPP.	15	.
NEEDLEGRASS	STIPA SPP.	15	.
PENSTEMON	PENSTEMON SPP.	15	.
WILLOW	SALIX SPP.	14	.
SEGOLILY MARIPOSA	CALOCHORTUS NUTTALLI	14	.
WOOLLY ERIOPHYLLUM	ERIOPHYLLUM LANATUM	13	.
BLACK CHOKECHERRY	PRUNUS VIRGINIANA MELANCOCARPA	13	.
BUFFALOBERRY	SHEPHERDIA SPP.	12	.
ACTINEA	ACTINEA SPP.	12	.
COCKLEBUR	XANTHIUM STRUMARIUM	12	.

FIGURE 83

COMMON NAME	SCIENTIFIC NAME	NO. OF OCCURRENCES	PERCENTAGE OF OCCURRENCE 0 10 20 30 40 50 60 70 80 90 100
PORCUPINEGRASS	STIPA SPARTEA	11	2.0%
ONION	ALLIUM SPP.	11	1.0%
ALKALI CORDGRASS	SPARTINA GRACILIS	11	.
GOLDENPEA (FALSE LUPINE)	THERMOPSIS MONTANA	11	.
BIG BLUESTEM	ANDROPOGON GERARDI	10	.
RUSH	JUNCUS SPP.	10	.
CANADA WILDRYE	ELYMUS CANADENSIS	10	.
ALFALFA	MEDICAGO SATIVA	10	.
CRESTED WHEATGRASS	AGROPYRON CRISTATUM	9	.
BEEPLANT	CLEOME SPP.	8	.
BORAGE	BORAGINACEAE	8	.
TRAILING FLEABANE	ERIGERON FLAGELLARIS	7	.
SANDWORT	ARENARIA SPP.	6	.
LITTLE RICEGRASS	ORYZOPSIS EXIGUA	5	.
BLACK NIGHTSHADE	SOLANUM NIGRUM	5	.
CLOVER	TRIFOLIUM SPP.	5	.
KENTUCKY BLUEGRASS	POA PRATENSIS	5	.
POISON IVY	RHUS RADICANS	5	.
BOXELDER	ACER NEGUNDO	5	.
LOCO	OXYTROPIS SPP.	5	.
BLUEGRASS	POA SPP.	4	.
CANBY BLUEGRASSS	POA CANBYI	4	.
CRYPTANTHA	CRYPTANTHA SPP.	4	.
SLENDER WHEATGRASS	AGROPYRON TRACHYCAULUM	4	.
PRAIRIE CORDGRASS	SPARTINA PECTINATA	3	less than 1.0%
BLUEJOINT REEDGRASS	CALAMAGROSTIS CANADENSIS	3	less than 1.0%
CINQUEFOIL	POTENTILLA SPP.	3	less than 1.0%
REEDGRASS	CALAMAGROSTIS SPP.	2	less than 1.0%
TIMOTHY	PHLEUM PRATENSE	2	less than 1.0%
CURRANT	RIBES SPP.	2	less than 1.0%

FIGURE 83

COMMON NAME	SCIENTIFIC NAME	NO. OF OCCURRENCES	PERCENTAGE OF OCCURRENCE 0 10 20 30 40 50 60 70 80 90 100
DROPSEED	SPOROBOLUS SPP.	2	less than 1.0%
POVERTYWEED	IVA AXILLARIS	2	less than 1.0%
NODDING BROME	BROMUS ANOMALUS	2	less than 1.0%
MOUNTAIN BLUEBELLS	MERTENSIA CILIATA	2	less than 1.0%
WHITE HORSENETTLE	SOLANUM ELAEAGNIFOLIUM	2	less than 1.0%
GIANTHYSSOP	AGASTACHE SPP.	1	less than 1.0%
FOXTAIL	ALOPECURUS SPP.	1	less than 1.0%
ARNICA	ARNICA SPP.	1	less than 1.0%
MILKWEED	ASCLEPIAS SPP.	1	less than 1.0%
CREEPING HOLLYGRAPE	BERBERIS REPENS	1	less than 1.0%
PLAINS REEDGRASS	CALAMAGROSTIS MONTANENSIS	1	less than 1.0%
PAINTBRUSH	CASTILLEJA SPP.	1	less than 1.0%
GOOSEFOOT	CHENOPODIUM SPP.	1	less than 1.0%
HAWKSBEARD	CREPIS SPP.	1	less than 1.0%
LARKSPUR	DELPHINIUM SPP.	1	less than 1.0%
COLORADO WILDRYE	ELYMUS AMBIGUUS	1	less than 1.0%
STRAWBERRY	FRAGARIA SPP.	1	less than 1.0%
BURSAGE	FRANSERIA SPP.	1	less than 1.0%
SKYROCKET	GILIA AGGREGATA	1	less than 1.0%
ST. JOHNSWORT (KLAMATHWEED)	HYPERICUM PERFORATUM	1	less than 1.0%
PEPPERWEED	LEPIDIUM SPP.	1	less than 1.0%
MAMMILLARIA	MAMMILLARIA SPP.	1	less than 1.0%
BLACK MEDICK	MEDICAGO LUPULINA	1	less than 1.0%
FALSE BUFFALOGRASS	MUNROA SQUARROSA	1	less than 1.0%
EVENING PRIMROSE	OENOTHERA SPP.	1	less than 1.0%
MALLOW NINEBARK	PHYSOCARPUS MALVACEUS	1	less than 1.0%
ANTELOPE BITTERBRUSH	PURSHIA TRIDENTATA	1	less than 1.0%
CONEFLOWER	RUDBECKIA OCCIDENTALIS	1	less than 1.0%
GROUNDSEL	SENECIO INTEGERRIMUS	1	less than 1.0%
GOLDENROD	SOLIDAGO SPP.	1	less than 1.0%

APPENDIX B   Section 6

UNITED STATES NATIONAL ATLAS
(Potential Natural Vegetation)

The Department of the Interior, at the time of publication of this report, is in the midst of preparing a National Atlas of the United States. Sheet 90 of this Atlas is reproduced on the opposite page for that part which covers the Middle Yellowstone Area.

The association of vegetation and the major species are as follows:

Grama-Needlegrass-Wheatgrass (Bouteloua-Stipa-Agropyron)

Physiognomy: Rather short, open to fairly dense grass

Dominants: Western wheatgrass (*Agropyron smithii*)
Blue grama (*Bouteloua gracilis*)
Needle-and-thread grass (*Stipa comata*)

Other Components: Bluebunch wheatgrass, little bluestem, fringed sagebrush, threadleaf sedge, hairy goldaster, broom snakeweed, Junegrass, dotted gayfeather, plains muhley, Sandberg bluegrass, sand dropseed, green needlegrass.

Eastern Ponderosa Forest (Pinus)

Physiognomy: Medium dense to open forest of low to medium tall needleleaf evergreen trees with a fairly open ground cover of grasses

Dominants: Ponderosa pine (*Pinus ponderosa*)

Other Components: Western wheatgrass, blue grama, needle-and-thread.

Northern Floodplain Forest (Populus-Salix-Ulmus)

Physiognomy: Low to tall broadleaf deciduous forest, open to dense, often with lianas

Dominants: Cottonwood (*Populus deltoides*)
Black willow (*Salix nigra*)
American (*Ulmus americana*)

Other Components: Boxelder, red maple,silver maple, American bittersweet, common hackberry, western virginsbower, white ash, red ash,common honeylocust, Virginia creeper, plains poplar, common poisonivy, peachleaf willow, sandbar willow, bristly greenbriar, snowberry.

Foothills Prairie (Agropyron-Festuca-Stipa)

Physiognomy: Open to fairly dense grassland of usually rather short grasses

Dominants:
Bluebunch wheatgrass (*Agropyron spicatum*)
Idaho fescue (*Festuca idahoensis*)
Rough fescue (*Festuca scabrella*)
Needle-and-thread grass (*Stipa comata*)

Other Components: Common yarrow, western wheatgrass, fringed sagebrush, blue grama, threadleaf sedge, Eriogonum spp., Junegrass, Pentstemon spp.,Sandberg bluegrass.

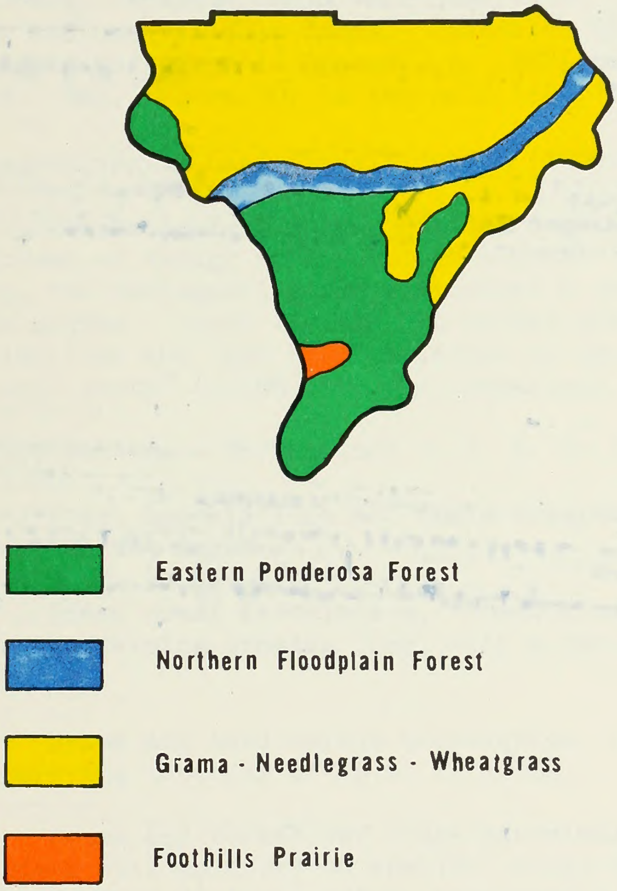
Wheatgrass-Needlegrass (Agropyron-Stipa)

Physiognomy: Moderately dense, short or medium tall grassland

Dominants:
Western wheatgrass (*Agropyron smithii*)
Blue grama (*Bouteloua gracilis*)
Needle-and-thread grass (*Stipa comata*)
Green needlegrass (*Stipa viridula*)

Other Components: Slender wheatgrass, pussytoes, fringed sagebrush, sedges, Junegrass, bluebells, Indian ricegrass, Pentstemon spp.

Plains only: Little bluestem, tarragon, sagewort, heath aster, blacksamson, dotted gayfeather, silverleaf scurfpea, goldenrod, porcupinegrass.



Potential Natural Vegetation

(A.W. Küchler, American Geographical Society, 1964, revised U.S. Geological Survey 1965 - U.S. National Atlas.)

Figure 84

LAND CLASSIFICATION RECONNAISSANCE (Circa 1924)

U. S. Geological Survey in 1924 classified lands for the Great Plains into three use classes - lands productive under irrigation, by dry-farming, or by grazing. 1/ Dry-farming lands in turn were subdivided into three subclasses: farming, farming-grazing, and grazing-forage lands. Grazing lands were subdivided into two subclasses; tillable and non-tillable lands. Standards of soil, topography and productivity are given in Appendix B. National Parks and Forests were excluded. Map, figure 30, in the main text, summarizes the report.

Range Vegetation in Land Classification (1924)

The Geological Survey divided vegetation into characteristic associations of forage or non-forage plants. In computing carrying capacity, the Geological Survey estimated a grazing season of from five to seven months. Their figures, in animal units per section, are generalizations and have been converted to the more common "acres per animal unit month" (A/AUM), to aid comparison with recent findings.

Plant Associations - Definitions U. S. G. S. (1924)

Plant associations and their attributes as described by the Geological Survey were: 2/

Grama grass association, a predominantly short-grass type found on the farming-grazing land, with a carrying capacity of 3½ to 6½ A/AUM.

Grama and needlegrass association, a more productive type, with a carrying capacity of 1½ to 3½ A/AUM.

Grama and threadleaf sedge association, an important indicator of deficient soil moisture on shallow, rocky or gravelly soils: carrying capacity of 3½ to 6½ A/AUM, and usually classed as farming-grazing land.

1/ Land Classification of the Northern Great Plains, Montana, North Dakota, South Dakota and Wyoming, U. S. Geological Survey 1929. Unnumbered.

2/ Currently accepted standardized plant names are substituted for U. S. G. S., plant names for uniformity. The original names used in 1924 are given in Appendix C.

Grama and western wheatgrass association, characteristic of the heavy clay loams, usually indicating farming-grazing or grazing-forage land; carrying capacity of 2½ to 4 A/AUM.

Grama and fringed sagebrush association, characterized soils with moisture in excess of the amount required for grama grass alone; classed as farming-grazing land with carrying capacity of 3½ to 7 A/AUM.

Grama and broom snakeweed association, generally found on the tillable grazing land, with carrying capacity of 6½ to 12 A/AUM.

Grama and silver sagebrush association. Found on deep, well drained soils capable of cultivation; carrying capacity of 2½ to 4 A/AUM.

Grama and buffalo grass association, similar to grama grass alone, but indicative of crop failure during years of less than average rainfall; carrying capacity of 4 to 6½ A/AUM.

Grama, buffalo grass and western wheatgrass association, usually found on the farming-grazing or grazing-forage land; carrying capacity of 4 to 6½ A/AUM.

Western wheatgrass association; carrying capacity of 5½ to 6½ A/AUM.

Sagebrush association, classed as grazing-forage and grazing lands, with carrying capacity of 6 to 9 A/AUM.

Forest associations, provided occasional grazing, but regarded as of low carrying capacity.

Salt grass association, regarded as indicative of soils containing sufficient alkali to preclude production of dry land crops.

Land Classification by County (1924)

The following excerpts from the 1924 Geological Survey Land Classification report are given here because of their value for comparison with present day conditions.1/

1/ The U. S. Geological Survey report of 1924 used exceptionally long paragraphs; for ease in reading, the original text is broken into shorter paragraphs.

Big Horn County (1924)

"The soil ranges from clay loam to sandy loam over most of the area mapped as tillable. In the Big Horn River Valley the soil generally is somewhat heavy, ranging from clay to clay loam, and most of the river valleys have a similar soil. Some of the heavy-soil bottom lands are strongly alkaline. The eastern part of the county has numerous red scoriacious or clinker-like hills formed by the burning of coal beds, and soils at many places in this area are mixed with particles of this clinker formation.

"The vegetation of the clay-loam and sandy loam bench lands is of a grama and needlegrass type, which is mixed with bluestem wheatgrass on the heavier soil and with threadleaf sedge on the lighter. Big sagebrush and wheat grass are the dominant species on the heavy clay soils, and the alkaline soils support a growth of salt grass and greasewood. Silver sagebrush is conspicuous on deep loam soils that have a favorable amount of moisture. Broom snakeweed is scattered over shallow soils or over-grazed areas, and fringed sagebrush grows on abandoned plowed lands. Little bluestem is conspicuous in the scoria areas of the eastern part of the county and elsewhere on steep sandy or rocky slopes. Prairie sandreed is found in some places with little blue stem and also occurs in bunches scattered over the light sandy soils of the county.

"A considerable portion of the county, especially the higher areas, is timbered, carrying for the most part a more or less scattered growth of small ponderosa pine, with numerous open grassland parks. Black chokecherry, saskatoon serviceberry, buffalo berry, rose bush, snowberry, currant, and other shrubs occur along the smaller creeks, and cottonwood trees grow along the larger rivers.

"The total area of the county is 3,209,000 acres, of which 3 percent is classified as irrigated land, 3 percent as farming land, 8 percent as farming-grazing land, 6 percent as grazing-forage land, and 80 percent as grazing land.

"As about 80 percent of the entire county is classified as valuable only for grazing the livestock industry is the outstanding one. The range is used primarily for spring, summer and fall grazing, although at lower altitudes where the range is protected in summer some winter grazing is done. The average length of the grazing season is eight months, the livestock being fed on hay for at least part of the time from about December 15 to April 15.

"The grazing capacity of the land ranges from about 20 animal units to the square mile on the poorest-grassed land to approximately 60 on the best-grassed lands, averaging approximately 35 or more. The number of range stock in the county on January 1, 1925, was equivalent to about 64,900 animal units, or less than 14 animal units to the square mile." 1/

Custer County (1924)

"The soil of the old plateau surface is chiefly sandy loam or clay loam. Some of the terraces have a shallow sandy-loam soil underlain by gravel, and others have a sandy or gravelly soil. The valleys have a clay loam or clay soil that is alkaline in places.

"The vegetation of the uplands is dominated by grama grass, which is associated with bluestem wheatgrass on the heavier soils and with needlegrass, prairie june grass, and threadleaf sedge on the medium and light textured soils. The clay-loam bottom soils support a grama and bluestem wheatgrass type, which is associated with silver sagebrush where the soil is of good depth and with big sagebrush or black greasewood where alkali is present.

"Small areas of pine hills occur that have a scattered growth of ponderosa pine with an undergrowth including the more prominent plains grass and weed species and small patches of little blue stem forming a conspicuous growth on the steeper slopes. The timber in these hills has little merchantable value and is used principally for posts or firewood.

1/ An eight month grazing season, as estimated in the 1925 report, would result in a rate of stocking equivalent to 4 surface acres/animal unit month (SA/AUM) on the lowest quality range; on the best range the equivalent would be 1.3 SA/AUM, and the average on all land would be 2.3 SA/AUM. The actual rate of stocking in 1925 was 5.7 SA/AUM. One cow with calf represents the standard "animal unit"; in the case of sheep, 5 adult animals are the equivalent of one animal unit.

"A few ash and boxelder trees grow along some of the intermittent creeks, and such shrubs as black chokecherry, saskatoon serviceberry, buffalo berry, willows and silver buffaloberry are prominent in coulees and low pockets that receive some extra moisture through surface runoff. Groves of cottonwoods occur along the larger streams.

"The county contains an area of 2,416,000 acres, of which 1 percent has been classified as irrigated, 8 percent as farming-grazing land, 14 percent as grazing-forage land, and 77 percent as grazing land."

Treasure County (1924)

"It is crossed from west to east by the Yellowstone River, which flows in a valley averaging about 4 miles in width and intrenched about 300 feet below the adjoining uplands. On the north the upland is a rolling and for the most part featureless plain except for more or less rough and broken areas bordering drainage channels. South of the river valley nearly the whole surface is broken and rough, very little of the land is sufficiently level for cultivation.

"The soil north of the Yellowstone River and east of Muggins Creek is principally a heavy clay and contains considerable alkali in places. West of Muggins Creek the uplands have lighter soils, but along the drainage channels heavy clay predominates. South of the river the soil is mainly sandy loam with some areas of clay.

"The well-drained heavy clay soils have a big sagebrush and wheat grass type of vegetation, and where alkali has accumulated Gardner saltbush, a scattered growth of inland saltgrass,pricklypear cactus, and inkweed,on low areas some black greasewood and some wheat and big sagebrush occur. Sandy loam and clay loam areas have a grame and needle grass type of vegetation. Broom snakeweed and fringed sagebrush are found in overgrazed areas, and broom snakeweed is also frequently found on rocky or shallow-soil areas. Much of the rough country south of the Yellowstone River and a small portion of the northwest corner of the county along the Bull Mountains has a scattered growth of small ponderosa pine. A few cottonwood trees grow on the larger alluvial flood plains and along the smaller creeks there are some cottonwoods with a fringe of small ash and boxelder. Shrubs found particularly in the southern part at higher altitudes are snowberry, rose, black chokecherry, and Saskatoon serviceberry. The normal annual rainfall ranges approximately from 13 inches in the northern part of the county to about 14 inches or possibly more in the southern part, and the growing season averages about 120 days.

"The total area of the county is 623,000 acres, of which 3 percent is irrigated, 7 percent is classified as farming-grazing land, 12 per cent as grazing-forage land, and 78 percent as grazing land. The irrigated lands lie along the Yellowstone River for the most part, and the principal crops produced are alfalfa and sugar beets.

"Stock raising is the dominant agricultural industry in the county and the total value of all livestock on January 1, 1925, was $656,000. The livestock comprised mainly 20,500 sheep, 10,300 cattle, 3,600 horses, and 3,000 swine. The range livestock was equivalent to about 18,000 grazing animal units,or nearly 20 animal units to the square mile of noncrop land."

"The area north of the Yellowstone is used principally for spring and fall sheep range and that south of the river for spring, summer and fall range for both cattle and sheep. Both areas are grazed as much as possible during the winter, but frequently for three or four months the snow cover is too deep to permit of grazing except by horses. Lack of water north of the Yellowstone and the hot weather are drawbacks to summer grazing. The grazing capacity ranges from 20 to 50 animal units to the square mile,averaging approximately 30 animal units."

Rosebud County (1924)

"In the southern part of the county, the upland plains have a sandy-loam or clay-loam soil that is both fertile and easily cultivated. In the rough areas heavy clays predominate, although coarser-textured types are found on small tracts.

"The loam soils of the uplands in the southern part of the county support a good growth of grama grass, needle grass, bluestem wheatgrass, prairie Junegrass, and a scattering of silver sagebrush. Threadleaf sedge is prominent on the light soils. On the larger alluvial flood plains groves of cottonwoods line the stream channels. In the small coulees snowberry, rose, black chokecherry, Saskatoon serviceberry, silver sagebrush, and buffalo berry form a prominent part of the vegetative cover, which includes most of the common plains-grass species.

"The pine-hills type is common in the southern part of the county and is featured by a scattered growth of scrubby ponderosa pine which is of little value except for fence posts or firewood. Little bluestem is prominent on steep slopes in areas of this type.

"The county includes an area of 3,196,000 acres of which 3 percent is included in the Custer National Forest, 1 percent is irrigated, 7 percent has been classified as farming-grazing land, 6 percent as grazing-forage land, and 83 percent as grazing land.

"The grazing land of northern Rosebud County has an average carrying capacity during the normal season of 18 to 25 animal units to the square mile, but in the southern part the carrying capacity is much higher and averages approximately 30 units. As 83 percent of the county is mainly valuable for grazing, the livestock industry will always be an important one here. The number of grazing animals in the county in 1924 was less than 13 animal units to the square mile of non-crop land which is probably 40 percent below the normal feeding capacity of the entire county."

ANNUAL PLANTS

Annual or biennial plants often blanket the range land suddenly and in such abundance that the perennial vegetation is invisible. For example, yellow sweetclover, Melilotus indica, covered thousands of acres in central Montana in 1963. Most of the blossoms were waist-high. The ground was not visible and travel on foot was difficult. The following year only traces of the tremendous sweetclover crop were apparent.

In 1961 on the lowest part of the Tongue River annual grasses, Japanese brome, Bromus japonicus, downy chess, Bromus tectorum, and sixweeks fescue, Festuca octoflora, covered the range. Figure 85. This infestation ran from the juncture of Pumpkin Creek with the Tongue River and westward to the rangelands south of Forsyth. The proportion of annual grasses to perennial grasses ran 90 percent annual grasses - 10 percent all other plants combined.

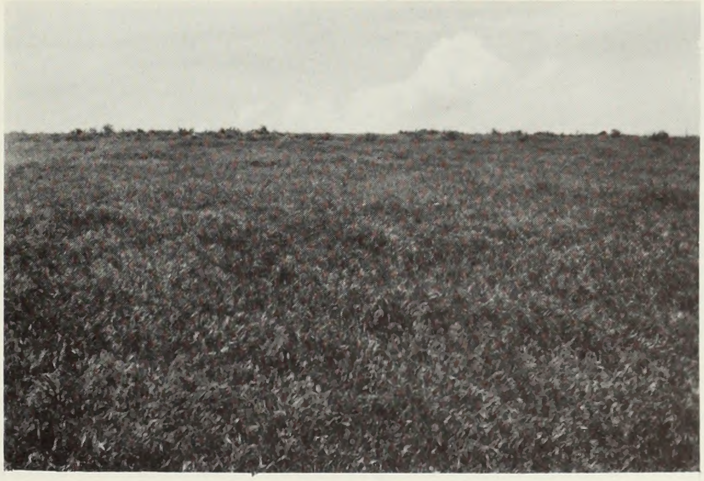


Figure 85 Annual grasses covered the range of the Middle Yellowstone Area in the spring of 1961. Several years of drouth followed by cold, wet spring produced this cover of 90 percent annual grasses.

Annual grasses were no problem locally on the shallow, rocky soils. The deeper, moderately saline soils were the ones most affected. Annual cover was greatest south of the Yellowstone River. Immediately north of the river annual grasses were in normal amounts on even heavier clayey and silty soil.

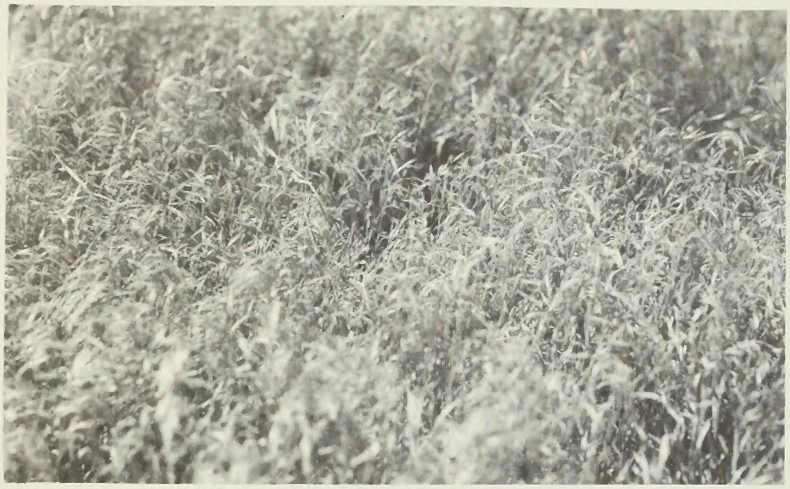


Figure 86 Closeup of ground cover of annual grasses in Figure

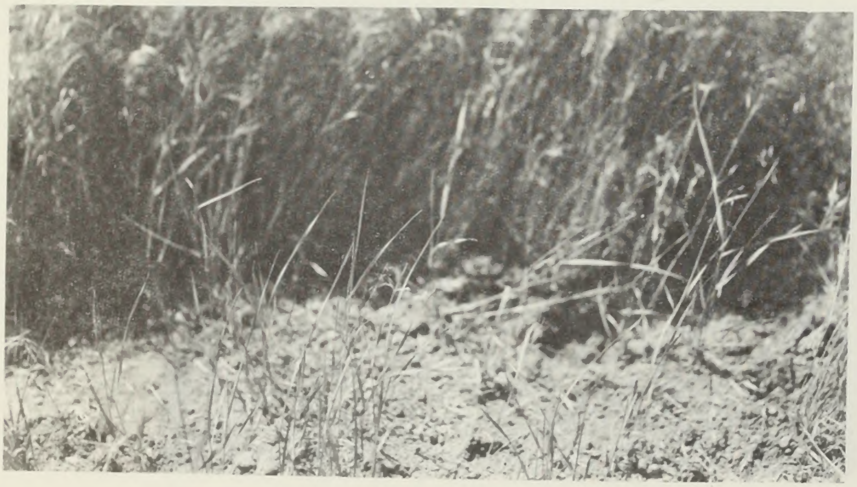
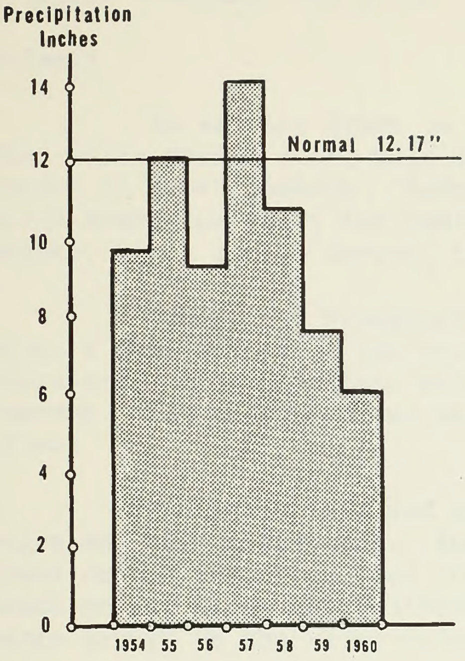


Figure 87 The camera in same position as above, Figure 86. Annual grasses are taken out to show the scattered perennial grasses completely dominated by the annuals.

On the Tongue River the problem of annual grass cover proved to be so great the "annual" area was reinventoried the following year. At that time annuals seldom reached 10 percent of the vegetation.

Annual cover is dependent on the effects of weather, soil and past use. Figure 88 shows an extended period of below-average annual precipitation prior to inventory. Perennial plants were weakened.



The rainfall in the mid-Middle Yellowstone Area was below normal from 1954 to 1960. Of 7 years, 5 were below normal; by 1960 the precipitation had dropped to one-half.

Figure 88 Annual Precipitation. Forsyth, Montana 1954-1960

Annuals are normally a part of all range sites; several nearby relict areas, ungrazed and inacccessible to livestock, were found to have from 10 to 15 percent of their cover made up of annual plants under normal weather conditions.

The spring of 1961 had numerous rains and low temperatures which encouraged the annuals. The shallow, rockier soils had better soil/water relationships and there the perennial grasses competed successfully with the annuals. The deep loams and sandy loams normally have a fair to good water relationship except when the soil is somewhat saline. This is common. Livestock-use on level lands is usually heavier than on surrounding hills but the ranges were not necessarily over-heavily grazed because the large area of annuals encompassed several ranches with differing types of range management. The annual cover in this area dropped back to normal by the next year.

The annual plant invasion of the deeper saline soils on the mid-Middle Yellowstone Area was due primarily to the effect of climate on vegetation. Soils and past use had a definite but lesser impact.

APPENDIX B Section 9

WILDLIFE - ANIMALS AND BIRDS

Animals

In earlier times in the Middle Yellowstone Area, the bison, elk, white tailed deer, mule deer, antelope, and bighorn sheep roamed in great numbers. Associated with them were the grizzly and black bear, the wolf, the smaller predatory animals such as the badger, coyote, black footed ferret, the foxes, and the skunks.

Today, the pronghorn antelope is the most numerous and conspicuous; a game animal of the open prairies, they are frequently seen by travelers. Most grassland animals, including the antelope, are swift runners. The pronghorn can maintain 40 or 45 miles an hour for several miles.

The white tail and mule deer frequent the forest woodland edges and open grasslands. The mule deer which is larger, is usually found on the ponderosa pine covered ridges. The white tailed deer are found mostly along the Yellowstone River; during summer they often form large groups on the river islands.

The wolf has disappeared, and coyotes are seldom seen. The skunk and badger are often seen at night along the edge of the roads.

The buffalo were responsible originally for close grazing of the grasslands. As they diminished, conditions that favored the prairie dogs declined. Prairie dog numbers have been in a continuing downtrend because of less favorable environment and due to poisoning campaigns. Better range management, with the return of taller grasses to the Middle Yellowstone Area is also responsible. The black footed ferret, that subsists primarily on the prairie dog, is also disappearing and is extremely rare. Both the black footed ferret, and its prey, the black-tailed prairie dog, are regarded as endangered species, with the possibility of becoming extinct. The other small mammals, such as the white-tailed jack rabbit are frequently seen on the grasslands. The much smaller cottontails live along sandy ridges or on the woodland's edge. Raccoons are very common, being seen in the evening or at night. The raccoon has extended its range westward with settlement of the area.

Most people will seldom see numerous tiny animals that subsist well on seeds of buffalo and blue grama grass, and the bulbs of wild onions plus a diet of grasshoppers, crickets, and spiders. These small mammals include the plains mouse, the deer mouse, and the prairie vole, which looks like a mouse; they all may be seen at times as they appear and disappear in the beam of the headlights at night. The larger, more easily identifiable, kangaroo rat makes its home in the sagebrush patches of the grasslands, and may be seen at night, rapidly bouncing as it travels.

The Northern pocket gopher, and the Richardson and 13-line ground squirrels are numerous, but the gophers are seldom seen. The ground squirrels stand by their burrows like tiny wooden statues. These burrowing animals are beneficial in the amount of subsoil they aerate, plus that which they bring to the surface. However, they compete directly with cattle and sheep for forage, making them unpopular. The badger, red fox, and coyote depend on ground squirrels and mice for much of their food.

Along the river, muskrat are numerous and beaver may occasionally be seen. Mink occur but rarely. A small amount of fur trapping is done in the Middle Yellowstone.

Birds

The Middle Yellowstone Area supports a richly assorted bird population; upland species and waterfowl are both prominent. The ability to recognize the more common birds adds to the interest of the area, whether one sees it as a resident, or a traveller.

One of the most distinctive species is the very common American magpie, a large and striking black and white bird. Easily seen on the highways, it flies quickly up at the approach of cars. Its diet is based heavily on the flattened jackrabbits and ground squirrels along the roads. The same is true of the crows and western ravens, both of which are larger and less common than the magpie. The attractive western meadowlark, with a yellow breast marked in black, looks and sings much like the eastern species. Fluttering in front of the cars and crossing periously close to the bumpers are many of the ground-nesting plains birds such as the horned lark and the lark bunting, and occasionally a bobolink.

In the marshes, the red-winged blackbirds and the brewer blackbird are common, flying in large flocks and mixing in the fields with the drab brown-black cowbirds.

Turkey vultures swing high in the sky during the summer months looking for dead animals. Below them, red-tailed, ferruginous, and Swainson's hawks fly at lower levels. The distinctively marked marsh hawk is often observed beating its way across the meadows and marshes searching for rodents. The tiny and attractive sparrow hawk is seen perched on telephone poles and wires. The red-headed woodpecker, handsome in red, white and black, is easily identified on dead trees, or as it is followed in its looping flight. The downy and hairy woodpeckers are far less conspicuous. The kingbirds are most easily spotted as they harrass an unwelcome crow or hawk.

The shrubs along fence lines near cultivated fields give good cover to ring-necked pheasants, an important game bird. Gray partridge, another introduced species, are seen in the brush of the uplands, but close to cultivation. This partridge is not as important as are the native sage grouse and sharp-tailed grouse that give excellent sport in upland game. Merriam turkey, a game bird, has been planted and is hunted.

Along the Yellowstone River the big blue heron is seen often in the tree tops, in rookeries along the Yellowstone River, or standing in the shallows spearing fish. Birds found in the marshes are the American bittern and two of the rails, the sora and Virginia rail. The long-billed curlew and the killdeer and avocet are frequently seen. A very common gull which might surprise the tourist is the Franklin gull, often called the "Prairie Dove". The mourning dove is a common bird seen flying to water, and its soft notes are heard throughout the subbasin.

Water birds are common. Sandpipers wander on the banks of the Yellowstone River, and use its islands as breeding grounds Canadian geese with their goslings are seen in nearly every bend of the river. In 1806, Clark remarked on the tremendous numbers of adult geese and young ones that passed him on the river. Clouds of resident marsh birds sometimes add a colorful and restless life to the wide-open spaces.

Ducks that occasionally breed in the area are the canvasback, gadwall, mallard, redhead, pintail, lesser scaup and shoveler, plus the blue-winged, cinnamon, and green-winged teal. The coot, the pie-billed grebe and western grebe are seen in nearly every pond. Herding their broods along the river are mergansers, especially the common merganser.

Included among the fast-flying, graceful swallows, are the cliff swallow, the violet-green, and barn swallow, all being very common. The gray-and-white shrike may have its reserve supply of grasshoppers neatly arranged on the barbs of fences along the highway. Other birds are not as easily seen; some, like the juncos are visitors, which pass through during migrations. Some birds are small and difficult to identify, including seven species of the sparrow. Wrens and kinglets may sometimes be seen in trees near the rivers. After dark the common night hawk may flash across the headlights searching for insects; but other nocturnal birds, like the great horned owl and screech owl are seldom seen.

APPENDIX B Section 10

PUBLIC CAMPSITES

Camping and Picnic Areas

Among the picnic and camping sites in the Middle Yellowstone Area are the following:

Forsyth Spring - 1 mile west of Forsyth, Montana
Water, stoves, tables, trailer space

Blue Star Memorial Park - 3 miles west of Miles City, Montana
Tables, space for four trailers, fishing

Water Plant Park - west edge of Miles City, Montana
Water, stoves, tables, toilets, unimproved camping facilities, overnight camping only

City Tourist Park - west edge of Miles City, Montana
Water, toilets, swimming, picnic tables, tennis courts

KOA Campground - west edge of Miles City, Montana

Spotted Eagle Recreation Area - west edge of Miles City, Montana
Picnic tables, fireplaces, toilets, boating, swimming, fishing, rifle range, archery range, skeet shooting

Riverside Park - Miles City, Montana
Picnicking only. Water, toilets, tables, boating, swimming

Picnic Site - 3 miles north of Forsyth, Montana
Tables

Campsite - Forsyth Boat Club - $\frac{1}{2}$ mile north of Forsyth, Montana

Area near Northern Cheyenne Arts and Crafts Museum - off Highway 212, about $\frac{1}{4}$ mile east of Lame Deer, Montana

Crazy Head Springs - approximately $1\frac{1}{2}$ miles south of Highway 212 - about 8 miles east of Lame Deer, Montana

Picnic Site - 3 miles west of Lame Deer, Montana
Tables, stoves, water, toilets

APPENDIX C

Section 1	Range Vegetative Types
Section 2	Method of Rangeland Inventory
Section 3	Guide to Plant Names as Used in U. S. Geological Survey 1924 Land Classification
Section 4	Definitions of Land Classes Used by U. S. Geological Survey Land Classification (1924)

APPENDIX C Section 1

RANGE VEGETATIVE TYPES

Authority BLM Manual 4412.11A

"Vegetative Types. The aspect vegetative types which are first used in mapping an area into range types are the same as the 18 standard types established some years ago.

"1 - Grass. Includes grassland other than meadow and secondary meadow. Perennial grasses predominate and determine the aspect, although forbs and shrubs may be present. Examples of types are: grama-buffalo grass, bunch grass, wheatgrass-sedge, alpine grassland, and blue stem.

"Where it is desirable to distinguish short and tall grass from mid-grass, these ecological variations may be designated, 1S-shortgrass and 1T-tall grass.

"2 - Meadow. Includes areas where sedges, rushes and moisture-enduring grasses predominate. Two classes of meadows are recognized: wet meadows and dry meadows.

"Wet meadow or marsh is characterized principally by sedges and remains wet or moist throughout the summer. These shall be designated as 2W.

"Dry meadow or flood plain is dominated by grasses rather than sedges and occur as moist meadowlike area or intermittent meadow, both of which become moderately dry by midsummer. These shall be designated as 2D.

"3 - Perennial forbs. Includes all untimbered areas where perennial forbs predominate over other classes of vegetation. There is very little true forb type, as a forb cover is usually more or less temporary in character and is soon replaced by a more permanent type if the disturbing factor is removed. If there is no great predominance of the forbs over the grass or shrub vegetation, and if it is possible to judge that the forb predominance is due to some unnatural factor, the forbs should be disregarded in designating the type and the more stable vegetation should be used as an index. The forbs will then be cared for in the subtype.

"4 - Sagebrush. This type includes all untimbered lands where sagebrush or shrubby species of similar character predominate. The sagebrush lands are usually of different range values and different in season of grazing from the areas which are listed below under mountain shrub. Areas dominated by shrubby species of sagebrush, including big sagebrush (Artemisia tridentata) shall be classed as subtypes, as for example: Artemisia filifolia, A. cana, and A. tripartita. Other shrubby species such as Chrysothamnus should be designated as subtypes when they become dominate in sagebrush areas.

"This and the mountain shrub type which follows are sometimes difficult to distinguish from the grass and forb types when aspect rather than the dominant class of forage is used as the distinguishing characteristic. Sagebrush may form only 15 percent of the total vegetation of a type and still its aspect may be that of a sagebrush type.

"It may prove desirable, in a given region, to decide on a certain percentage of all the vegetation in the type, say 20 percent, as the minimum proportion of sagebrush that may be present if the area is still to be classified as a 4 type, providing, of course, it does not already have the aspect of some other type. The same will hold true of the mountain shrub.

"5 - Mountain shrub. This type includes all untimbered lands where mountain shrubs, excepting sagebrush or its subtypes, gives the main aspect ot the type or is the predominant vegetation. Characteristically it occupies the transition zone of the lower mountain slopes, foothill, and plateau areas. Examples of subtypes are mountain mahogany, bitter brush, willows, Ceanothus, manzanita, California chaparral, etc.

"6 - Conifer. This type includes all range in coniferous timber supporting grasses, forbs, or shrubs, either singly or in combination, except as provided under types 7 and 9. The forage may vary from a pure stand of pinegrass, or some other grass, to a pure stand of forbs or shrubs. It usually, however, consists of grasses, forbs, and shrubs, and the proportion of each species varies so widely that it is not thought advisable to attempt a division into types with distinct colors. These variations can best be represented by subtypes.

"7 - Waste. This type includes all areas of dense timber and brush which have no value for grazing domestic livestock or have such slight value that they cannot be used economically, owing either to denseness of standing or down timber or sparseness of forage growth. Large areas of very sparse forage, unless within easy reach of a better type, shall be classified as waste because of the impracticability of running stock over so large an area to get such a small amount of feed.

"This type also includes other waste areas not strictly in timber or brush and not barren, but so rough or inaccessible as to make their future use improbable.

"The subtype designations generally encountered in this type are as follows: 7T-waste in dense timber; 7D-waste in down timber; 7B-waste in brush; 7R-waste areas where rocky character prevents use; and 7I-permanently inaccessible areas. Principal species of timber should be shown by symbols.

"For any 7 type which is or can be used by game animals, the type number is modified by adding after the "7" designation the number (in parentheses) of the aspect vegetative type involved. This combination type number will indicate value for game forage and habitat.

"8 - Barren. This type includes all areas on which there is no natural vegetation, or practically none, including intermittent lake beds, saline flats, active sand dunes, shale, rock slides, lava flows, etc. Areas which have been denuded by overgrazing or other causes should not be confused with areas naturally barren, nor should areas containing only annuals for a part of the year be shown as "barren" although these may be without vegetation for the remainder of the year.

"9 - Pinon-juniper. This type includes pinon, juniper, pinon-juniper, and digger pine. The character of the range in this type as regards location, grazing capacity, and management is sufficiently distinct from the conifer type to justify a separate color. The forage may vary from a pure stand of grasses, forbs, or shrubs to a combination of any two or all. This variation can best be shown by subtype designations.

"10 - Broad leaf trees. This type includes all range in deciduous timber. The combination of grasses, forbs, and shrubs, and the proportion of individual species, will vary as in other types.

"The principal subtypes which will be encountered are: aspen, cottonwood, oak, birch, alder, ash-elm, etc., when they occur in tree form.

"13 - Saltbush. This type includes areas where the various salt desert shrubs of the Atriplex genus form the predominant vegetation, or give the characteristic aspect. There is sufficient significant difference in the range value and the use of saltbush areas to justify their separation from other desert or semidesert shrub types.

"14 - Greasewood. This type includes areas where greasewood (Sarcobatus) is the predominant vegetation or gives a characteristic aspect. Usually this type occupies valley floors subject to overflow during flood periods or areas underlain with ground water at shallow depths where the soil is more or less saline. It is sufficiently differentiated from other desert shrubs to justify an exclusive type.

"15 - Winterfat. This type includes areas where winterfat (Eurotia) gives a characteristic aspect or constitutes the predominant vegetation. Though commonly associated with other semidesert shrubs, the occurrence of this plant in Utah and Nevada as a type character is of sufficient extent to justify a separate type.

"16 - Desert shrub. This is a general type which includes areas where other desert shrubs aside from those separated into individual types, constitute the predominant vegetation or give the characteristic aspect. This type includes several genera which are quite distinctive in type habit such as black brush (Coleogyne), coffee berry (Simmondsia), catclaw (Acacia or Mimosa), gray molly (Kochia), hopsage (Grayia spinosa), and spiny horsebrush (Tetradymia spinescens), but pure types of each are too limited in extent to justify separate types. The plant symbols used will be sufficient to indicate the predominant species present.

"17 - Half shrub. This type includes areas where half shrubs constitute the dominant vegetation or give the characteristic aspect.

"Half shrubs are semiwoody perennials of low stature such as Aplopappus, Gutierrezia, Artemisia frigida, Eriogonun wrightii, etc. They commonly consist of a woody caudex from which herbaceous stems are produced that die back annually. These genera are sufficiently distinctive in habitat and of wide enough extent in certain localities to justify a separate type designation.

"18 - Annuals. This type includes areas in which annual forbs or annual grasses constitute the dominant vegetation. Both transitory stages and semipermanent conditions should be included in this type as for example: russian thistle, downy chess (*Bromus tectorum*), and desert forbs. The plant symbols used will be sufficient to indicate the predominant species present.

APPENDIX C Section 2

METHOD OF RANGELAND INVENTORY

The ecological method of range inventory was used on the River Area. This system states what is the potential production of the rangeland, in terms of quantity and kinds of forage, and then relates the present range production to that potential.

Range was defined as lands on which the original plant community is one of native grasses, forbs and shrubs. This includes lands with low grazing value, such as desert, badlands and other naturally barren and semi-barren lands - but excludes forested areas.

Range classification by the ecological method rests on two essential concepts. The first concept is that of dividing the range area into "range sites". The second concept is that of the "climax" plant community that develops under the regional climate but is strongly influenced by the unique environment of each range site.

Range Sites

Range sites can be located and mapped because each may be described in terms of soil depth, soil texture, topography, parent materials, alkalinity or acidity, stoniness, slope, exposure and organic matter.

Range sites are held to a minimum number. A new range site is proposed only if a need develops for a different evaluation. The site must have either, (1) differences in species of the climax plant community, or (2) differences in the range sites total plant production, or both. But these differences must be great enough to require some variation in management.

Plant Communities

The sum of influences peculiar to each range site leads to the development of its characteristic and unique plant community.

When the range site and its plant community is modified in some way, such as an increase of soil fertility or a decrease in light intensity, the environment may favor some plants more than others. One plant species may replace another, or one plant community replace another, and this second community may be replaced by a third, in a series of stages moving towards the climax community. The final stage, the climax, persists as long as there is no change in climate.

Within a particular climatic region changes on all plant communities tend towards one uniform climax plant community. For example, the tall-grass prairie (big bluestem, switchgrass, indiangrass) occurs on limestone, granite, clays and shales, floodplain deposits, sands and calcareous marls. Exceptions to this one-climax plant community are usual and this is the basis for a range site.

Within a particular climatic region with its characteristic climax plant community the range site itself limits the vigor of individual plants, their productivity, and the community composition. For example, soils developed from marine shales may be saline or alkaline and have plant communities that differ markedly in composition and vigor from adjacent plant communities that occur on salt-free soil. A plant climax on the optimal soils characteristic for a climatic region is called the climatic climax; the community that develops on soils which strongly influence the climatic change is called an edaphoclimatic climax, (Greek - edaphos, soil),because the influence of soil and climate are nearly equal. This is the concept of the range site and its climax community.

Application

A guide for field crew use is prepared. A range site field guide covers large physiographic areas such as the Montana Glaciated Plains (about one-third of the State). The guide has descriptions of both the range site and its unique climax plant community. In preparing the guide, description of the range site is usually easy; description of the climax plant community is more difficult.

The climax plant community for a range site is found in part by searches for protected or relatively undisturbed rangeland. Disturbance is normal to most sites, which may be used by wildlife even if not by livestock. The plant community of the least disturbed range sites represents the potential vegetation reasonably well. (This is not always true as undisturbed sites will show unexpected departures from a concept of luxuriant grass or forb cover. One relict in the saline soils of the Red Desert of Wyoming was nearly 100% horsebrush, a poisonous plant. This example is rare but such evidence must be considered in evaluating other relicts.)

Grazing district records, experiment station ranges are also investigated. A search is made of scientific literature and of historical accounts. The evidence from any one source cannot be conclusive - all are considered.

The guides, in their limits of plant occurrence, necessarily include a broad range of abundance possible for the species of the climax community - because the range site itself varies.

Extensive range sites with similar soils and topography may differ in forage production, therefore, very large range sites often must be divided into precipitation zones.

Range sites are permanent, their climax plant communities, if disturbed, will re-establish, although the plant cover may be changed temporarily by drouth, grazing, fire, or farming. Sometimes one factor is so drastic in its action the range site is changed permanently.

The impact of farming, for example, may be so prolonged as to change the original range site by excessive soil loss through erosion. A new range site with its altered potential is then described. (Range sites are named, if possible, from the physical character of the site, i.e., Badlands or Saline Uplands, etc.)

Range Condition

In practice range condition is found by listing the relative quantities of plants. This is compared with the climax plant community of that range site. Differences,if any, are described in four classes as "Excellent", "Good", "Fair", or "Poor". (Note: These are poorly chosen words that lead often to misinterpretation of the intent of ecological inventories. But they are used in range management literature so extensively these classes are retained in Missouri River Basin use.)

These classes show the degree to which the present plant community, estimated to the nearest five percent for each plant, departs from that of the climax plant community. 1/

This vegetative benchmark is necessary and departures are stated by percentages because the range forage is harvested by animals. Grazing and browsing animals are selective and will use their preferred feed.

(A range site with its unique climax plant community if it were grazed by sheep would lose forbs and browse plants to become more of a grassland. Cattle use would result in much less grass and more forbs and brush. Goats or deer would remove more of the shrubby species. All of these departures from the climax are most simply expressed quantitatively by percentage rather than by unwieldly descriptions.)

1/ The estimates for present and climax plant community is volume production, the relative quantities produced by each species. This includes all photosynthetic surfaces. Prickly pear,for instance, will have succulent pads many years old, which compete for light and water. Brush, on the other hand, is considered only as to the leaves and the current annual growth of twigs.

Community Reactions in Determining Range Condition

First, plants of the climax community are grouped as decreasers, increasers, or invader plants. These groups represent the plant's reaction to heavy grazing pressure.

Under continued heavy grazing:

1. Decreaser plants slowly disappear relative to the other plants in the community.

2. Increasers replace the decreasers. Increasers have a limit in the climax; not until the decreasers dwindle away can the increasers spread out into the newly available space. Under heavy grazing low-value increaser plants will usually seize territory faster than high-value plants.

This limit on increaser plants is a key in calculation. Our base point is the most stable plant community - the climax. Plants limited in the climax community therefore indicate a change to unstable conditions when they exceed that limit. The plant guide lists each increaser plant species with its limit for each range site, amounts in excess are disregarded.

Ignoring the presence of invader plants, the steps are now:

1. Total the percentages of all decreaser plants. (Decreaser plant species are in the guide for each range site.)

2. Increasers are totalled in their present quantity also, but only to that limit of each species in the climax community. Any excess is ignored. (The increaser plant species and its limit is in the guide for each range site.)

3. These two amounts are totalled - decreasers as found plus allowable quantities of increasers.

The score, the total of decreasers and allowable quantities of increasers is: 0-25 percent - Poor, 25-50 percent - Fair, 50-75 percent - Good, and over 75 percent is rated Excellent.

One group of plants, invaders, have been ignored. Invaders move into the plant communities as the increasers begin to disappear under continuous heavy use. They are not a part of the climax plant community of the range site so cannot enter into the calculation of any departure from climax.

Invaders include all annuals. Woody plants, and herbaceous perennials are list in the range site guide for the sites on which they are considered invaders. (Invaders are present in the climax as, for example, sunflowers on the raw soil at the entry to a rodent burrow, but the five percent increments in estimating forage would eliminate their consideration.)

Results

Management is not predicated on high scores in range condition. It is based on the appropriate kinds of plants on the range. Spring range with annual grasses might be far from the original plant community for the site, yet meet the exact need for economic management. The ecological system of range inventory uses the original plant community as the benchmark to which the ever-changing rangelands can be referenced. Goals can be envisioned and results forecast by use of the concepts of range site and its climax vegetation.

Guide to Plant Names as used in U. S. Geological Survey 1924 Land Classification

U. S. G. S. Land Classification 1924		Standardized Plant Names
Common Name	Scientific Name 1/	Common Name
GRASSES AND GRASSLIKE PLANTS:		
Blow out grass	Redfieldia flexuosa	Blowoutgrass
Blue grass	Poa pratensis	Kentucky bluegrass
Big blue stem	Andropogon gerardi	Big bluestem
Little blue stem	Andropogon scoparius	Little bluestem
Brome grass	Bromus spp.	Brome
Buffalo grass	Buchloe dactyloides	Buffalograss
Fescue	Festuca spp.	Fescue
Foxtail	Hordeum jubatum	Foxtail barley
Giant wild rye	Elymus cinereus	Giant wildrye
Blue grama	Bouteloua gracilis	Blue grama
Side oats grama	Bouteloua curtipendula	Sideoats grama
Long awn needlegrass	Stipa comata	Needleandthread
Short awn needlegrass	Stipa viridula	Green needlegrass
Pine grass	Calamagrostis rubescens	Pinegrass
Prairie june grass	Koeleria cristata	Junegrass
Redtop	Agrostis alba	Redtop
Rushes	Juncus spp.	Rush
Sand dropseed	Sporobolus cryptandrus	Sand dropseed
Sand grass	Calamovilfa longifolia	Prairie sandreed
Salt grass	Distichlis stricta	Inland saltgrass
Nigger wool	Carex filifolia	Threadleaf sedge
Prairie sedge	Carex stenophylla	Needleleaf sedge
Wire grass, triple awn, or poverty grass	Aristida longiseta	Red threeawn
Slender wheat grass	Agropyron pauciflorum	Slender wheatgrass
Wheat bunch grass	Agropyron spicatum	Bearded bluebunch wheatgrass
Western wheatgrass	Agropyron smithi	Bluestem wheatgrass
SHRUBS:		
Buckthorn	Rhamnus spp.	Buckthorn
Buck brush	Symphoricarpos spp.	Snowberry
Buffalo berry	Shepherdia argentea	Silver buffaloberry

1/ Scientific names are in accord with current taxonomic nomenclature

Section 3 Guide to Plant Names (U. S. G. S.)
(App. C Cont.)

U. S. G. S. Land Classification 1924		Standardized Plant Names
Common Name	Scientific Name [1]	Common Name
SHRUBS:		
Chaparral	Ceanothus spp.	Ceanothus
Chokecherry	Prunus melanocarpa	Black chokecherry
Cinquefoil	Pontentilla fruticosa	Bush cinquefoil
Creeping juniper	Juniperus spp.	Juniperus
Currant	Ribes spp.	Currant
Gooseberry	Grossularia spp.	Gooseberry
Greasewood	Sarcobatus vermiculatus	Black greasewood
Kinnikinnick or Bearberry	Arctostaphylos uva-ursi	Bearberry kinnikinnick
Matchweed	Gutierrezia sarothrae	Broom snakeweed
Mountain mahogany	Cercocarpus	True mountain mahogany
Oak brush	Quercus spp.	Oak
Prickly pear	Opuntia spp.	Prickly pear
Rabbitbrush	Chrysothamnus spp.	Rabbitbrush
Black sagebrush	Artemisia tridentata	Big sagebrush
Bud sagebrush	Artemisia spinescens	Bud sagebrush
Green sagebrush	Artemisia dracunculoides	Falsetarragon sagebrush
Mountain sagebrush	Artemisia frigida	Fringed sagebrush
Sand sagebrush	Artemisia filifolia	Sand sagebrush
Valley sagebrush	Artemisia cana and	Silver sagebrush
	Artemisia gnaphalodes	Cudweed sagebrush
Shadscale	Atriplex confertifolia	Shadscale saltbush
Salt sage	Atriplex gardneri	Gardner saltbush
Soapweed	Yucca glauca	Small soapweed
Squawberry	Shepherdia canadensis	Russet buffaloberry
Serviceberry	Amelanchier alnifolia	Saskatoon serviceberry
Wild red plum	Prunus americana	American plum
Wild rose	Rosa spp.	Rose
Willows	Salix spp.	Willows
Winter fat	Eurotia lanata	Common winterfat
WEEDS:		
Astragalus	Astragalus spp.	Loco; milkvetch; poisonvetch
Balsam root	Balsamorhiza sagittata	Arrowleaf balsamroot
Butterweed	Senecio spp.	Groundsel
Daisy	Erigeron spp.	Fleabane
Gumweed	Grindelia squarrosa	Curlycup gumweed
Loco weed	Oxytropis spp.	Crazy weed

[1] Scientific names are in accord with current taxonomic nomenclature

U. S. G. S. Land Classification 1924		Standardized Plant Names
Common Name	Scientific Name 1/	Common Name
Lupine	Lupinus spp.	Lupine
Phlox	Phlox hoodi	Hoods phlox
Psoralea or wild alfalfa	Psorelea tenuiflora and Psorelea argophylla	Slimflower scurfpea Silverleaf scurfpea
Purple cone flower	Echinacea angustifolia	Blacksamson echinacea
Russian thistle	Salsola kali	Russianthistle
Stickweed	Lappula occidentalis	Stickseed
Sunflowers	Helianthus and Helianthella spp.	Sunflower
Thistle	Carduus spp.	Bristlethistle
Vetch	Vicia spp.	Vetch
Wild buckwheat	Eriogonum spp.	Eriogonum
Wild flax	Linum lewisi	Lewis flax
Yarrow	Achillea millefolium	Common yarrow
TREES:		
Ash	Fraxinus spp.	Ash
Aspen	Populus tremuloides	Quaking aspen
Balsam or alpine fir	Abies lasiocarpa	Alpine fir
Box elder	Acer negundo	Box elder
Cottonwood	Populus spp.	Cottonwood
Cedar or juniper	Juniperus spp.	Juniper
Douglasfir	Pseudotsuga menziesi	Common Douglasfir
Elm	Ulmus americana	American elm
Engelmann spruce	Picea engelmanni	Engelmann spruce
Limber pine	Pinus flexilis	Limber pine
Lodgepole pine	Pinus contorta latifolia	Lodgepole pine
Western yellow pine	Pinus ponderosa	Ponderosa pine

1/ Scientific names are in accord with current taxonomic nomenclature

Definitions of Land Classes Used by U.S. Geological Survey Land Classification (1924)

Irrigated and Irrigable Land:

Deep soils, actually irrigated or potentially irrigable land already under a ditch.

Dry-Farming Land:

Dry-farming land had a smooth surface. Climatic conditions, soil texture, and fertility were favorable to successful production of hardy grain crops in most years. Soil textures ranged from sandy-loam to clay-loam; the minimum precipitation was from 14 to 20 inches; 50 percent or more of the total precipitation occured from May to September, with a growing season of 100 to 120 days.

Farming-Grazing Land:

Farming-grazing land had a smooth to gently rolling surface. Climate, soil texture, and fertility were favorable to the successful production of grain crops 75 percent of the time, but yields were minimum; precipitation was from 12.5 to 17 inches; 50 percent or more of the total precipitation occurred during the 6 month period from April to September. This was land on which a farmer could earn a livelihood every year and make a moderate profit for at least two-thirds of the years.

Grazing-Forage Land:

Grazing-forage land had a smooth to gently rolling surface Climate, soil texture, and fertility were such that grain crops could be successfully produced only occasionally. Soils in this classification had a friable texture but were clay or coarse-sandy to gravelly type, either incapable of readily absorbing or retaining moisture. Normal rainfall ranged from 10.5 to 13 inches. Wheat or rye, cut green for hay, was considered the only sure crop in this land. Most of the area thus classified would always be used for livestock grazing.

Grazing Land:

Grazing land was divided into two classes: tillable and non-tillable. Tillable grazing land was relatively smooth and physically tillable, which, because of low rainfall or heavy or shallow soil, was unfit for profitable production of crops. Non-tillable grazing land included all remaining lands that could be used only for grazing or timber production, rough broken mountain slopes and plains dissected by erosion into rough breaks and badlands, as well as gravel terraces.

Missouri River Bottom-land:

These were river-bottom lands between nearly parallel lines of bluffs; the alluvial plains formed by the stream flowing through them. Soil textures varied from very fine loam to sand. The subsurface was usually saturated with ground water. Most of such land, especially the better types, were irrigated.

Stony Land:

Stony lands were areas of level to gently rolling land with a surface mantle of glacial debris of large stones or boulders from three to five inches or larger, and used only for grazing.

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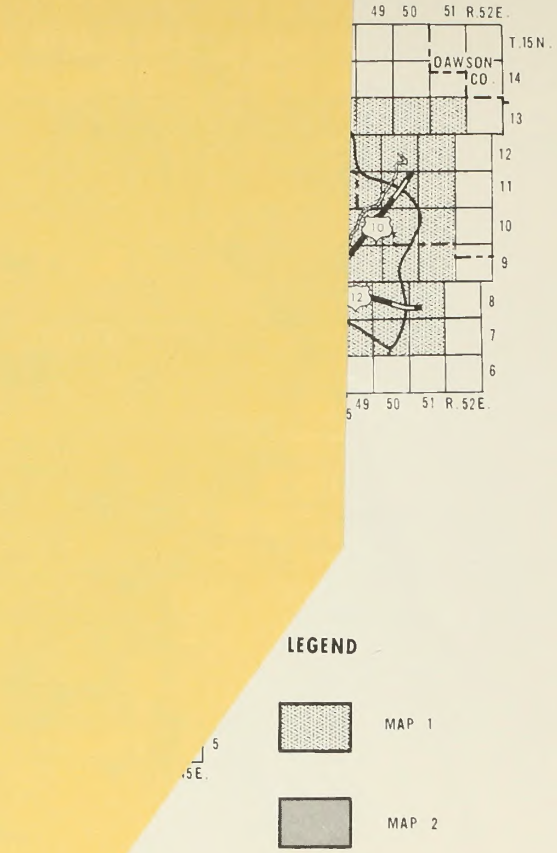
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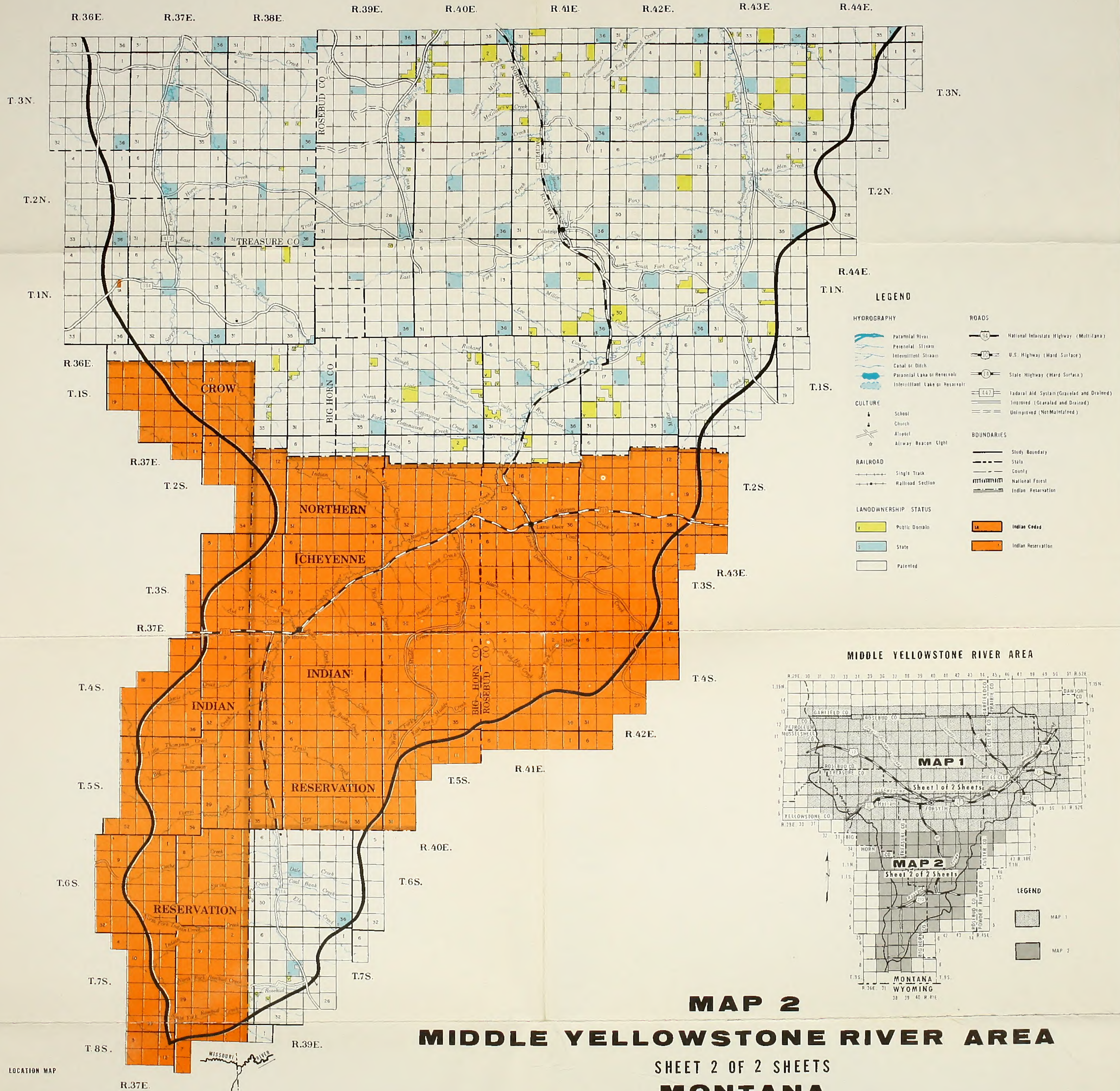
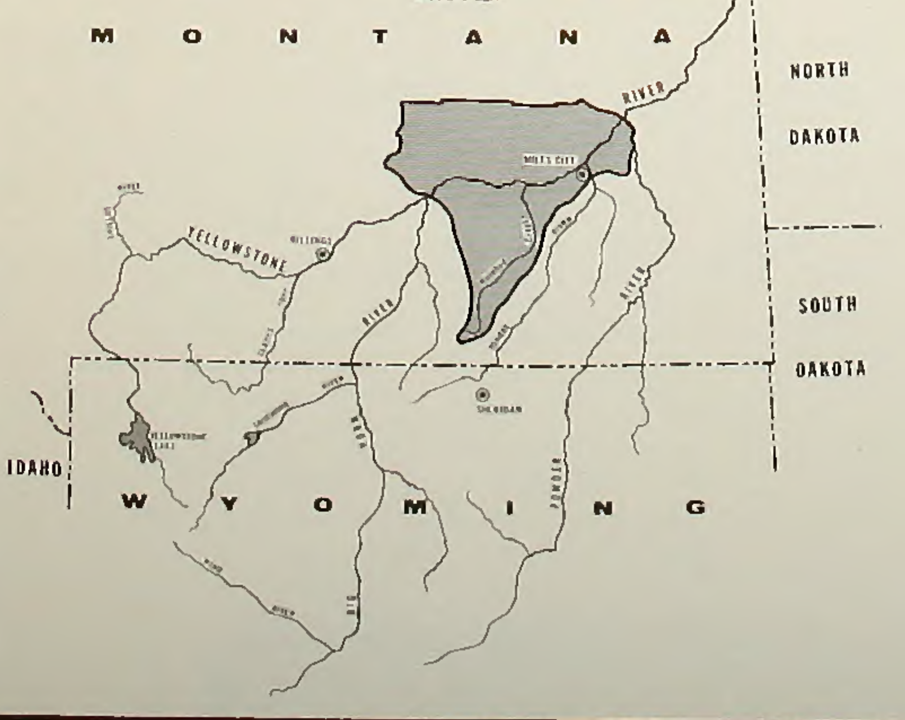
LEGEND
MAP 1
MAP 2

UNITED STATES DEPARMENT OF THE INTERIOR

BUREAU OF LAND MANAGEMENT



LOCATION MAP



MAP 2

MIDDLE YELLOWSTONE RIVER AREA

SHEET 2 OF 2 SHEETS

MONTANA

MISSOURI RIVER BASIN STUDIES
DENVER SERVICE CENTER
DENVER, COLORADO
1966

Scale 1: 253,440
1 0 1 2 3 4 5 6
MILES

John L. Kovacs

UNITED STATES DEPARMENT OF THE INTERIOR

BUREAU OF LAND MANAGEMENT

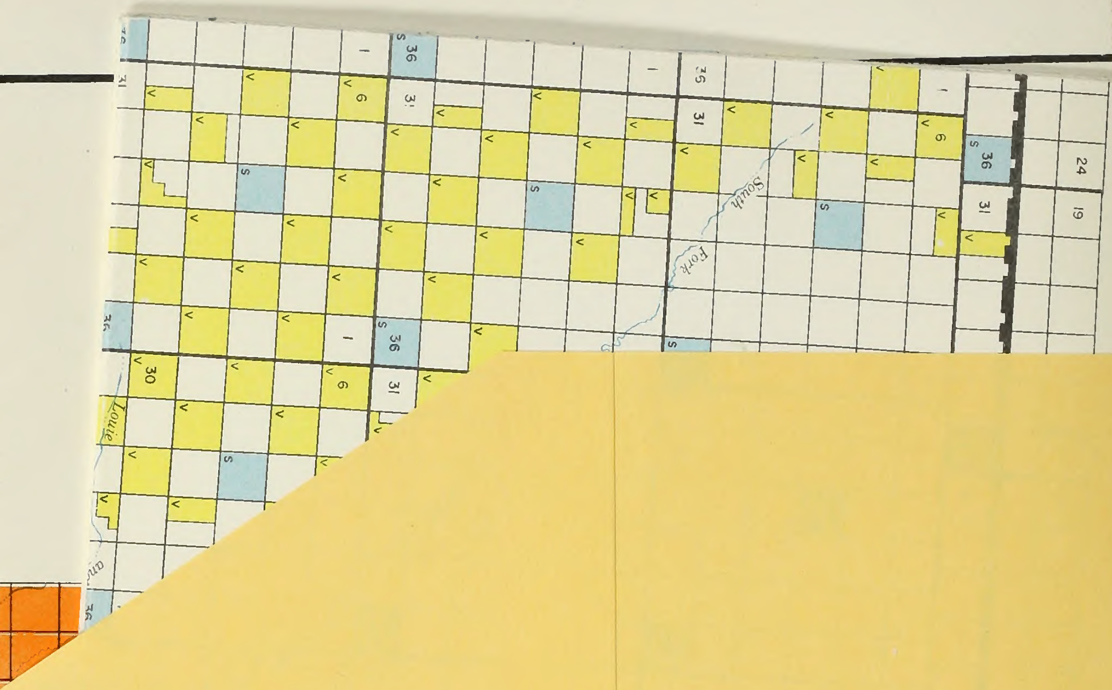
MAP 1

MIDDLE YELLOWSTONE RIVER AREA

SHEET 1 OF 2 SHEETS

MONTANA

MISSOURI RIVER BASIN STUDIES
DENVER SERVICE CENTER
DENVER, COLORADO
1966



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